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ABSTRACT

This teaching guide focuses on Arctic-nesting shorebirds. The format of each section consists of background information, student activities, observation and research ideas, and key words. Basic information on how to use this curriculum and seven sections devoted to different aspects of Arctic-nesting shorebird life are provided. Sections cover topics such as general information about shorebirds, adaptations, habitat, nesting and breeding habits, migration, the shorebird sister schools program, field trips, and tying it all together. A bibliography and five appendices (A-E) contain shorebird coloring pages, build a shorebird card masters, advanced reading suggestions, advanced activities, shorebird field study card masters, and additional information on shorebird species. (DDR)

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ARCTIC-NESTING SHOREBIRDS

Curriculum for Grades K-12

By Maureen de Zeeuw

Revised from:
"Shorebirds of the Pacific Flyway: an information and activity guide"

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1998

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Arctic-Nesting Shorebirds was expanded from ***Shorebirds of the Pacific Flyway: an information and activity guide***, distributed by the U.S. Fish and Wildlife Service at the Alaska Maritime National Wildlife Refuge office in Homer, Alaska. Several of the activities have been adapted from Project WILD, Alaska Wildlife Curriculum, and other curricula from around the U.S. which are referenced in the activities and in the bibliography on the last pages.

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ARCTIC-NESTING SHOREBIRDS

TABLE OF CONTENTS

Grades Page
INFORMATION FOR TEACHERS 1

INTRODUCTION TO SHOREBIRDS

Chapter Concepts 3
General Information
What Are Shorebirds? 5
Activities
Shorebird Profiles 4-12 11
Student Readings:
Western Sandpiper 13
Dunlin 15
Dowitcher 17
Black-bellied Plover 19
Student Worksheet 21
Anatomy of a Shorebird Diagrams 3-12 23
Student Worksheets 25
Additional Activities K-12 27
Key Words 28

ADAPTATIONS

Chapter Concepts 29
General Information
Shorebird Adaptations 31
Activities
Build a Shorebird 2-9 32
What Can I Eat With This Beak? 2-8 40
Student Worksheet 42
Avian Olympics 6-9 44
Student Worksheet 48
Additional Activity/Observation/Research Ideas K-12 51
Key Words 53

HABITAT

Chapter Concepts 55

General Information

Shorebirds Depend on Three Habitats 57
What is a Wetland? 60

Activities

Five Types of Wetlands Frequently Used by Shorebirds 3-12 61
Additional Activities K-12 64

Student Readings:

Stream and River Corridors 66
Tundra 68
Marshes 70
Rocky Intertidal 72
Mudflats and Sandy Beaches 74
Wetland Metaphors 2-9 76
Match the Habitat Cards 5-12 79
Describe a Local Habitat 4-12 85
Map Your Habitats 2-12 86
Letter Writing 2-12 89
Additional Activity/Observation/Research Ideas K-12 90
Key Words 93

NESTING AND BREEDING

Chapter Concepts 95

General Information

Nesting and Breeding 97

Activities

Guard Your Nest 2-7 102
BehaveYourself! 2-8 108
You be the Scientist 5-12 113
Bubble Map 4-12 117
Gee Whiz Facts: *Eggs and Nests* 120
Additional Activity/Observations/Research Ideas K-12 121
Key Words 125

MIGRATION

Chapter Concepts 127

General Information

The Magnificent Migrant 129
Bird Banding 135

Activities

- *Migration Headache* 2-8 138
- *Migration Math Madness* 4-9 142
  - Student Reading 143
  - Map 144
- *Shorebird Circle Puzzle* 3-12 145
- *Bird's Eye View* 2-12 147
- *Bird Beans* 2-10 148
  - Student Reading: *Sampling Populations* 153
  - Student Worksheet 154
- *Banded Birds* 2-12 155

Gee Whiz Facts: *Migration* 164

Additional Activity/Observation/Research Ideas K-12 165

Key Words 168

SHOREBIRD SISTER SCHOOLS PROGRAM

Using the Internet and E-mail to Teach Students about Shorebirds 2-12 169

FIELD TRIPS

Chapter Contents 173

Teacher Information

- *Peak Migration Dates* 175
- *Checklist* .... 176.
- *Suggestions* 178
- *Group Management Hints* 180
- *Etiquette* 181
- *Safety* 183
- *Video Hints* 184

Pre-Trip Activities

- *Field Guide & Glasses Practice* 4-8 186
- *Map & Miles Study* 3-9 189
- *Making Sampling Equipment* 5-9 190

Field Trip Activities

- *Shorebird Field Study* K-12 192
  - Student Worksheet 193
  - Shorebird Observation Record Sheets 195
- *Cast a Track* 2-9 197
- *Mud Creature Studies* K-12 199
  - Student Reading 201
  - Invertebrates Forms 202
  - *Techniques for Viewing with Sampling Equipment* 204
  - Diagrams: *Marvelous Mud Meals* 205
- *Sampling Populations in the Field* 8-12 207

Post-Trip Activities

Dunlins and Foxes Game 2-6 212
Sharing Circle 2-7 213
Data Analysis 4-9 214

TYING IT ALL TOGETHER

Chapter Concepts 215

Activities

Decision Dilemmas 6-10 217
Dilemma Cards 223
Shorebird Wax Museum 2-5 224
A Year (or Week or Day) in My Life as a Shorebird 3-12 226
Shorebird Poetry 3-12 228
Can Do: Wetlands! 7-12 229

Sharing and Review Activities

Shorebird News 7-12 232
Shorebird Speeches and Listening Tests 5-12 234
Shorebirds on Display 4-12 236
Shorebird Fair K-12 237

Review Activities

Wild Spellers! 2-6 239
Shorebird Jeo-Bird-y 5-12 241

BIBLIOGRAPHY 251

APPENDICES

Shorebird Coloring Pages . . . . Appendix A

"Build a Shorebird" Card Masters . . . . Appendix B

Nesting and Breeding Advanced Information Reading, Student Worksheet, Worksheet Answer Key, and Additional Activities for Advanced Reading . . . . Appendix C

"Shorebird Field Study" Task Card Masters . . . . Appendix D

Additional Information on Shorebird Species . . . . Appendix E

INFORMATION FOR TEACHERS

Arctic-Nesting Shorebirds contains information and activities designed to help students develop a variety of academic and life skills while learning about migratory shorebirds, shorebird habitat, and the significance of human interaction with both. Most activities are adaptable for use whether you live near a shorebird breeding or wintering area, migratory stop-over sites, or in a geographic region that hosts birds for a combination of these.

Although the activities are written primarily for grades 2 through 12, some, including field trips, can easily be modified for younger children. "Additional Activities" sections at the end of chapters also include lessons for younger students. Substantial background "General Information" is included on various aspects of shorebird life history. This information is written at adult reading level and intended primarily for supplementary use by middle/high school teachers or students, or for other interested teachers. "Key Words" are listed at the end of each chapter (after "Additional Activities"). These key words are italicized in bold where they appear in the text.

FIELD TRIPS

Timing: The field trip is an ideal focal point for the study of shorebirds. Plan ahead because timing of field trips is very important. You want to ensure that students have the best chance to see some shorebirds! If you are not familiar with the timing of the occurrence of shorebirds in your area, contact a local resource person, or see the Shorebird Sister Schools Program (see page 169) or the Field Trip section (page 175).

Activities: Although a chapter specifically on field trips is included, be sure and skim the entire curriculum before you arrange a trip. Several activities that appear in other chapters can be used with field trips or will be enhanced by directed observations made in the field.

OTHER TIPS BEFORE YOU START

Consider videotaping, or having students videotape, some activities and community participation during the course of your shorebird unit. Videotapes are fun to make and can be very useful for learning by watching one's work or performance. Videos also provide a means of sharing experiences with others in a Parent Night or Fair.

Have your students make, or provide your students with, small notebooks dedicated to their shorebird investigations or activities. Consider investing in waterproof paper. "Rite-in-the-Rain" waterproof notebooks are available in forestry or research supply stores, but may be expensive.

Recruit a team of parents, elders, and government or research specialists to help with your shorebird unit.

Begin a collection of current newspaper and magazine articles on a related theme like habitats, human use of wildlife habitats or resources, threats to habitat, or migratory animals. (Students can help with this collection.) These articles can come in handy for activities with older students that focus on these subjects or skills such as writing, comparison-making, journalism, or careful and critical reading, to name just a few.

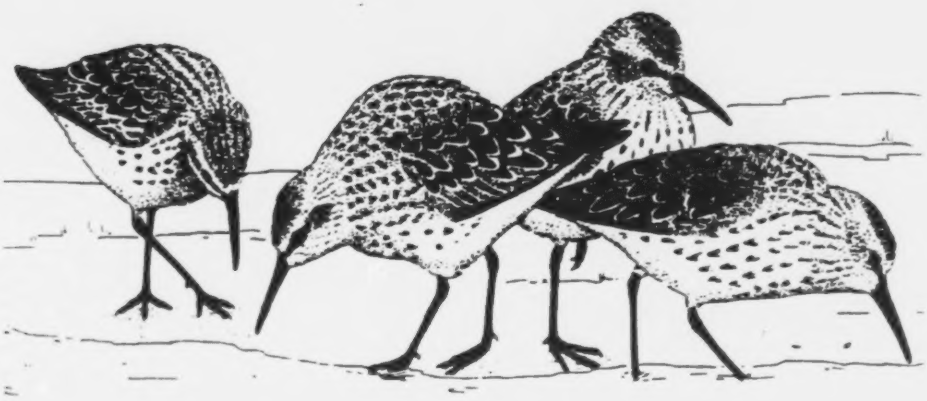
Begin the unit by giving an oral or written pre-test on shorebirds. For example, you can give students 5 minutes to do a fast-write on everything they (think they) know about shorebirds. Use this information for directional ideas as well as end-of-unit comparisons.

INTRODUCTION TO SHOREBIRDS

CONCEPTS:

- Shorebirds are birds specially adapted to live in open land and often near water.
- Many shorebirds are migratory.
- Arctic-nesting shorebirds form some of the largest migratory flocks of all the species of vertebrates.
- Learning about representative species of shorebirds can help us learn about shorebirds in general.

WHAT ARE SHOREBIRDS?



Land and water - they are the two most basic geographic features of the Earth's surface. What happens along the narrow lines where these two great bodies meet? This fragile strip contains some of the greatest ***diversity*** (variety of living organisms) on our planet. It is enriched by life-sustaining water, yet must also endure some very powerful natural forces. It is called the ***shore***, and it is land which faces regularly and irregularly-changing periods of drying out, dampness, or flooding beneath water; a tremendously fluctuating range of salinity; and erosion by wind and water.

Organisms that live in this precious environment have adapted to thrive in these conditions. ***Shorebirds*** are a group of special birds which are adapted to live near these coasts or shores. Because of their habit, particularly during their spectacular migrations, of walking through water and mud to find food, Europeans call these long-legged birds "waders".

Each spring and fall, enormous flocks of shorebirds swarm along the coasts in great ***migrations***. It is a thrilling sight when the shore comes alive with feeding birds, or a flock swiftly wheels and turns in flight. These flocks pulse to and fro with the cycles of the tides, and, on a broader scale, with the cycles of the seasons. Shorebirds eat, breed, travel, and rest as a part of these ***cycles of nature***.

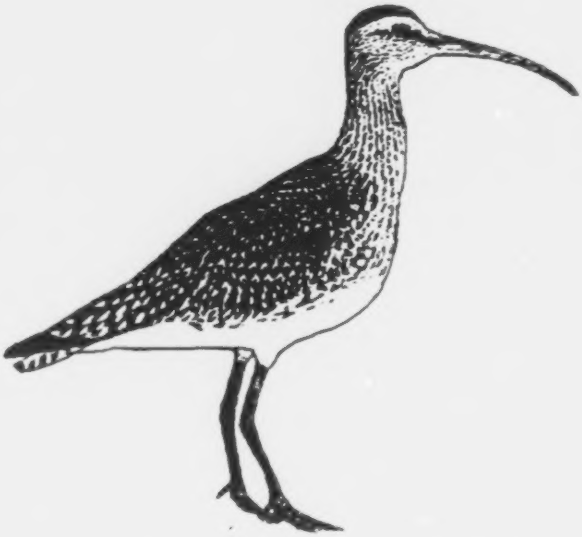
Shorebirds are more accurately described as birds of open land, including, but not limited to, the shore. Shorebirds include the sandpipers, plovers, oystercatchers, snipes, and stilts, among others.

Besides their regular migrations, their lifestyle includes other highly developed rituals of behavior, including elaborate courtship displays. Most of us have never had the pleasure of witnessing these displays because many migratory shorebirds nest in remote Arctic tundra or open grassland.

There are about 214 species of shorebirds in the world. Almost 80 of these regularly occur in North America. Seventy-five species breed in the ***Holarctic*** region, which means they nest and raise young in either the North American Arctic (***Nearctic***) or Northern Europe and Russia (***Palearctic***). See if you can tell why this might be so by looking at a globe.

MORPHOLOGY

Morphology refers to what an organism physically looks like. Shape, color, and size are all examples of morphology. In his book Shorebirds of the Pacific Northwest, Dennis Paulson states, "each shorebird is a beautifully functioning organism, the parts finely tuned by natural selection to work together to adapt the bird to its environment."



One of the most striking physical traits of shorebirds is their stately posture. They stand up very straight on long legs. Shorebirds that wade to find food have the longest legs. They also have long pointed bills that they use to probe in the mud or water for small animals to eat. Shorebirds have long pointed wings and are strong, fast fliers. There is variation among the species, but in general their size is relatively small.

The coloration of shorebirds might at first be thought of as rather ordinary. However, one realizes the value of their brown, banded plumage the first time one sees a beach with 10,000 legs! Their coloration is an adaptation of ***camouflage***. Shorebirds are generally speckled brown, rusty, and white on the back. Some have white or black patches on the head, breast or belly. They blend in well with the sandy, muddy, or grassy areas where they feed and nest. Their camouflage helps protect them from predators such as eagles, hawks, gulls, and foxes.

Shorebirds have darker colors on their back than on their belly. Have you ever seen a flying flock of brown sandpipers turn together in the air and suddenly appear white as their undersides are flashed at you? Perhaps this bicoloration is an adaptation similar to that of many fish: when observed from below, against the light, the bird is inconspicuously light-colored to a potential predator. When a flying hawk observes shorebirds from above, the darker backs blend in with the beach or mudflat. As you learn more about shorebirds and their environment, see if you think this theory makes sense.

BEHAVIOR

One of the most notable and beautiful characteristics of shorebirds is a particular ***behavioral*** adaptation - scattered feeders lift off and swiftly consolidate into a graceful ***flock*** at the approach of a predator. Because of being in a large group, each individual's chance of being eaten is reduced. Some shorebird species are generally solitary, but most will readily join a flock in response to disturbance. Mixed-species flocks are common. Mixed-species flocks also make birdwatching more fun for the beginner, who can use contrasts of size, color, or behavior to spot different species.

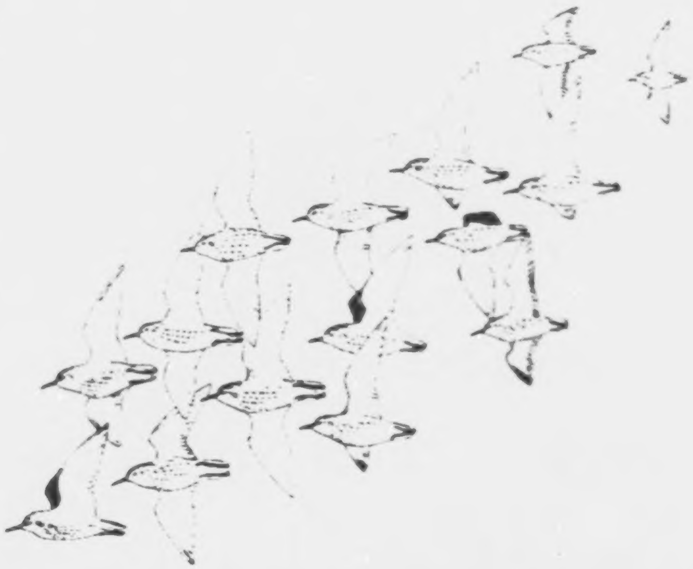
During the breeding season, shorebird pairs defend ***territories***. In the following lessons, we will learn more about how and why they do that. Individuals of some species also defend mobile feeding "territories" around their moving bodies as they forage during the winter.

Another distinctive behavioral adaptation of shorebirds is their one-legged posture while roosting. Keeping one leg and the bill tucked under the body feathers conserves heat, an important consideration in the often chilly open areas of their habitat.

MIGRATION

The tremendous importance of the strategy of migration to shorebirds cannot be overstated. Most shorebirds migrate long distances between their summer and winter homes. They are dependent upon at least three distinct habitats: their breeding habitat, nonbreeding habitat, and stopover sites along the migration routes. They are physically designed for long-distance flight, as you will learn in the activities to follow.

All Arctic-nesting shorebirds migrate. The ***Arctic*** refers to that region of our globe that is in the far north, generally north of the imaginary latitude line known as the Arctic Circle (66° 33'N). Some shorebirds that breed in northern Alaska spend the winter as far away as southern Chile. Some plovers, curlews and tattlers fly non-stop from Hawaii and other South Pacific islands to Alaska, a distance of over 3,500 miles, in two or three days. Many species of shorebirds form large flocks for the long migrations between North America and South America.



Flock of Western Sandpipers

FEEDING AND HABITAT

Shorebirds depend upon ***wetlands*** for food. Wetlands include marshes, river deltas, mud flats, tundra, and intertidal areas. While wintering and migrating, shorebirds feed upon tiny clams, snails, sand fleas and worms in the mud and sand near the water's edge. Bill size and shape, like coloration, is an ***adaptation*** to the shorebird's environment. Shorebirds with short bills probe for animals which live very near the surface. Those with longer bills can reach animals buried deeper in the mud. Millions of shorebirds breed and raise their chicks each summer in the Arctic. During the short breeding season in the northern tundra, they feed on insects, grubs and worms that they capture in the vegetation.

When humans fill wetlands with gravel to construct parking lots and buildings, shorebirds cannot find food. Many shorebirds return instinctively to the same feeding areas every time they migrate. Thousands, hundreds of thousands, and even millions of shorebirds might be found together in one place during migration. If the wetlands to which they return each year by instinct are destroyed, they do not have the ability to look somewhere else. Even if they did, where would they find another wetland when all the wetlands have been filled? Where will the shorebirds go? What will the shorebirds eat?

IDENTIFICATION

Some people think shorebirds are hard to identify, but it's a skill anyone can learn if they know what to look for. Here are some clues:

- Notice the size. Large shorebirds are about the size of robins or pigeons. Small shorebirds are about the size of sparrows.
- Notice the color of the ***plumage*** (feathers). Look for distinct white, rust, or black patches. Does the bird have spots or streaks on its breast?
- Is the bill long or short? Is it straight or curved slightly up or down? What color is the bill?
- What color are the legs?
- When the bird is flying, can you see wing stripes or a distinct tail pattern?
- Observe its behavior. Is it picking up its food or probing below the surface for prey? Is the bird you are observing alone, in a small group, or part of a large flock?

IMPORTANCE OF SHOREBIRDS

Did you know that shorebirds contribute to a healthy ***ecosystem***? An ecosystem is the collection of all living and nonliving things within a particular geographic area. For example, some of the components of an ecosystem might be land, water, shorebirds, phytoplankton, zooplankton, fish, and ***guano***. The living components of any ecosystem have adapted to live and reproduce in the presence of the other particular components, and rely on many of them.

Shorebird droppings, called guano, fertilize the mudflats in which they feed and the water over which they fly. The guano helps microscopic plants, called ***phytoplankton***, grow. The phytoplankton form the base of the food chain upon which the fish we eat depend.

Because shorebirds are dependent upon wetlands, they are good indicators of wetland health. The health of an ***indicator species*** tells biologists something about the health of other creatures using plants composing that habitat. For instance, if there is a change in population of a shorebird, then perhaps populations of worms on which it feeds are being similarly changed. A change in condition of one shorebird species might lead us to hypothesize that other shorebirds using the same resources will be similarly affected. Perhaps one of the ***abiotic*** (nonliving) components of the ecosystem, like the water, is polluted. An indicator species is usually an easily observable organism, and you might find that a change in a shorebird population is the first indication, or hint, that a water source is polluted.

Think of some other indications that studies of shorebirds might give us about a habitat or other species. How many ***hypotheses*** can you come up with to finish this sample sentence: If shorebirds at my local pond (or beach or *estuary*) are declining in population (or health or number of healthy chicks produced), then perhaps it is because_________________________________
____?

- Activity -

SHOREBIRD PROFILES

Grade level: 4 - 12

Objectives: By reading details about four representative shorebirds, students will be introduced to the general lifestyle and adaptations of Arctic-nesting shorebirds. Explore values associated with, as well as threats to, shorebirds. Practice critical reading and comparison skills.

Duration: One 40-minute class period

Materials: Copies of four Profile readings
Copies of worksheet table which follows Profiles.

Procedure:
On the following pages are profiles of four Arctic-nesting shorebirds which are commonly seen in Alaska and the Pacific Northwest, and an accompanying worksheet. Have students fill out the accompanying worksheet table, or use the table as guidelines for a discussion of the species information.

Note: One way to help students 1) remember the material and 2) understand important general facts about shorebirds is to encourage them to make ***direct comparisons***. Some tips to help with this, to be selected or modified depending on student level, include instructing students to:

- Avoid simply listing information under each heading.

- Ask themselves what they are comparing (e.g., what four different shorebirds look like, what four different shorebirds eat, etc.). Ask themselves what are the similarities between the species and what are the differences.

- Confine the number of ***variables*** to as few as possible. In this case, the only variable should be "species". For example, when comparing what different species eat, don't compare food eaten in winter to food eaten in summer (unless you indicate that you are aware you are introducing season as another variable). To put it another way, if we know only the color of one bird's head, the color of another's tail, and the color of a third bird's wings, we don't really know if all three birds are identical or if they are as different as a green-headed Mallard, a Red-tailed Hawk, and a Buff-breasted Sandpiper.

- Try translating the table to ***sentence form***: "The similarity between the way a female Western Sandpiper and a female Dunlin behaves is -----. The difference between their behaviors is -------".

Extensions:

1. **"Jigsaw"** the profile readings: divide the class into four cooperative groups which are each responsible for reading and teaching *one* of the readings. Pass out copies of the Western Sandpiper reading to all members of one group, copies of the Dunlin reading to the next, etc.. Give the groups 30 minutes to prepare presentations on their reading. Have the group members decide on individual tasks. One member of each group can be in charge of drawing a picture of the bird in its described habitat, another member or two can be assigned to draw a color-coded map showing where the bird occurs, and two other students can prepare the oral presentation. To ensure careful attention during presentations, each group can write two quiz questions on their own bird and turn these in to the teacher. The teacher then chooses at least one question from each group and gives a short quiz after the presentations.

2. **Community Research.** Have students do research among elders, biologists, and/or birders in their community for supplementary and local information on these or other shorebirds.

3. **Literature/Library Research.** Have students practice library research skills, writing, and use of sources by doing their own research on additional species.

4. **Map Study.** Using the readings, have students study maps and the globe to determine the approximate length of migration for each of these species. Which appears to migrate the farthest? Also using maps and the globe, students can determine how many different countries each bird may visit or fly near in a year of its life if it flies such-and-such distance.

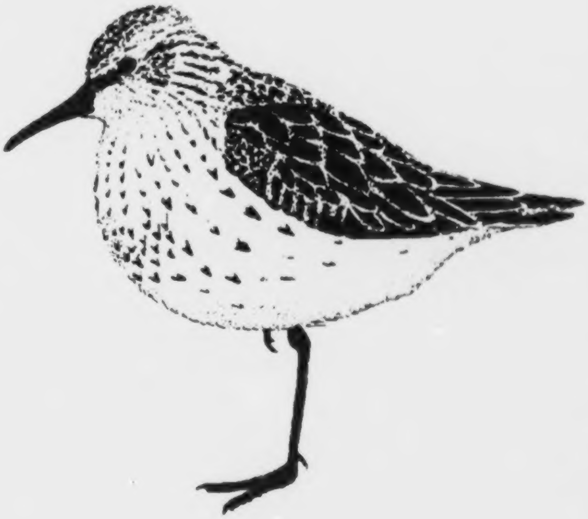
5. **Creative Writing.** Have students choose one of the shorebirds and write a creative story about it, based on at least five facts from its profile.

Older/Advanced Students:

6. **Natural Selection.** Advanced students can practice critical thinking skills by choosing one behavioral or morphological ***adaptation*** given for a bird and coming up with their own one-two paragraph theory on how or why this trait evolved. In other words, the student must consider the environment and fellow organisms of the bird. Then have the student research to see if his/her theory was accurate. Alternatively, the students can present their theory to the class and have it voted on for approval. For example, what is the "background" against which the Western Sandpiper blends in? How does the Western Sandpiper feed on tiny clams, worms, and sand fleas? (Mechanically, how does a shorebird's bill help it capture the most amount of food?) How does it defend its nest against other birds? Why do Western Sandpipers build their nests close together? Why are wetlands important as feeding areas?

7. **Researching Scientific Names/Latin Roots**. Have students research what they can about the meanings of the Latin or ***scientific names*** of these and other shorebird species. Many shorebird species are divided into localized, genetic races. Interested students might also compare the meanings of the Latin names of these races, and compare this to what is known about or differentiates between these races.

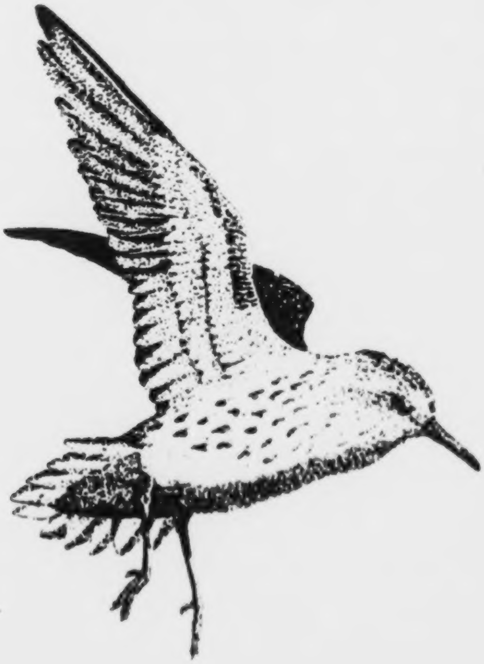
WESTERN SANDPIPER (*Calidris mauri*)



The Western Sandpiper is a very small shorebird, only 6 $^1/_2$ inches from the tip of its bill to the tip of its tail. It has speckled rust and tan colors on its head and shoulders. Its belly is an off-white to light buff-color. You can see dark, arrow-shaped spots on the breast and sides. This coloration helps the little Western Sandpiper to blend very well with its background. Its toes are slightly webbed and its legs are black. The slender, black bill droops a little at the tip.

Males and females look alike, but females are heavier and have longer bills.

In the winter, Western Sandpipers are found along the coast from California to Peru. Early in April, they form huge flocks and begin the long migration to breeding grounds in the far north. Most fly to Northwestern Alaska. Some even fly across the Bering Sea to the eastern tip of Russia!



Thousands and thousands of Western Sandpipers fly along the Pacific coast of North America, stopping from time to time for much needed rest and food. As the bird walks near the water's edge, they constantly probe in the mud for tiny clams, worms, and sand fleas. The movement of their busy little bills has been compared to the up and down motion of sewing machine needles. During migration and in the winter, Western Sandpipers are found mostly on the coast, but can also occur in inland wetlands. Have you seen them in wetlands near your home or school?

The male Western Sandpiper usually arrives in the tundra breeding area in mid-May, a few days before the female. ***Tundra*** is vast, open habitat with no trees in the far north. Tundra is dotted with pools of water and small ponds because the frozen ground (***permafrost***) beneath the surface does not allow good drainage.

The male selects a nesting site on the tundra and he then defends it against other males. When the female arrives, she helps the male build a shallow, grassy nest. Western Sandpipers build their nests fairly close together (their territories are tiny) on small, grassy mounds on the tundra. The nest is often hidden beneath a low shrub.

The female lays four spotted eggs in the nest and the parents take turns incubating them. The chicks hatch after 21 days. They are covered with soft, speckled down and begin searching for food right away. Like most other shorebirds which nest on the tundra, Western Sandpipers feed on the hordes of insects which hatch there each summer.

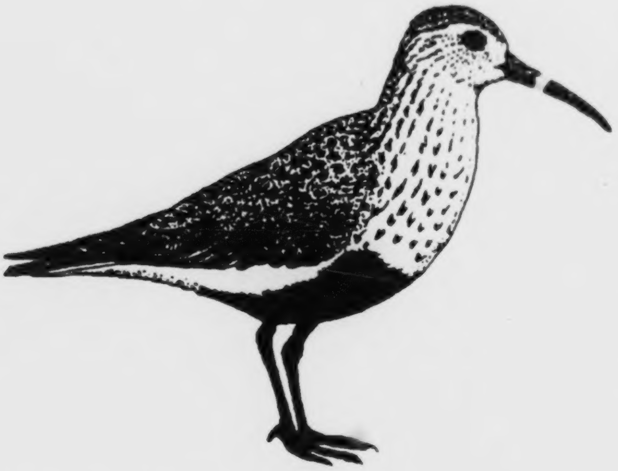
The Western Sandpiper has to be on watch for predators like foxes, weasels, and gulls. The parent will sometimes pretend it has a broken wing, and drag itself away from the nest to distract a predator. (Remember, if a predator attacks the parents can fly, but the chicks cannot.) Another defense the chicks have is their instinct to "freeze", sitting perfectly still, when a parent gives an alarm call.

At first both parents tend the young birds, but the female leaves a few days before the chicks are ready to fly. The male stays with the chicks until they can fly (when they are about 19 days old).

Adult birds gather to begin the long flight south by the end of July. Young birds remain in the nesting area of the tundra, gorging themselves on insects and exercising their young flight muscles. In mid-August they, too, are ready to form large flocks and fly south for the winter. How do they know how to find their way? Stay tuned, and hopefully you will learn something about the "mystery of migration" as you study shorebirds.

Western Sandpipers rely on wetlands for feeding areas. Slowly, one by one, wetlands are being filled with gravel and concrete to make parking lots and building sites. Some towns in the United States and Canada have passed laws to protect wetlands from destruction. What are people in your area doing to help save wetlands for wildlife?

DUNLIN (*Calidris alpina*)



Dunlin in Breeding Plumage

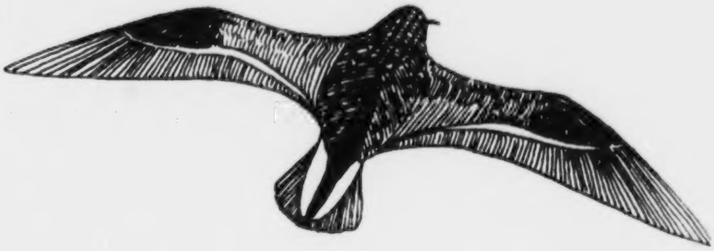
The Dunlin is a truly pretty bird. It is smaller than a Robin - about 8 inches from bill tip to tail tip. The Dunlin has reddish speckled back feathers and a light-colored breast with dark streaks. It used to be called the red-backed sandpiper. It has black legs and a black bill that droops a little. Its call heard during migration is a slurred "kreep".

The most distinctive trait of the Dunlin's plumage is seen during breeding season (the summer), when it is the only shorebird besides the Rock Sandpiper with a black belly patch. Even in a giant flock of little "peeps" (small shorebirds), a few of those tar-black patches will give away the presence of Dunlins!

Dunlins are amazing to watch. They fly in large flocks and every bird in the flock flies at the same speed and in the same direction. They all turn at the same time and make you wonder how they do it. During migration and winter, Dunlins feed near the water's edge by probing with swift movements in the soft mud for tiny clams, worms, and shrimp-like animals.

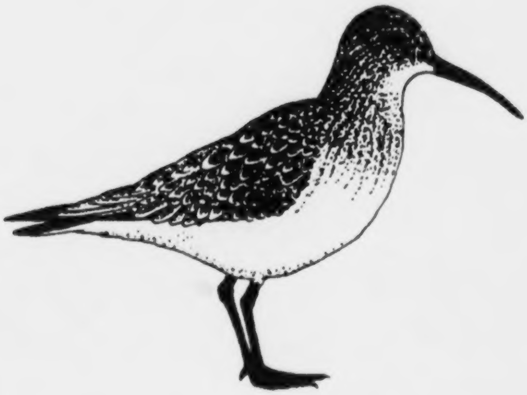
In the winter, Dunlins live along the shore in warm climates of the Northern Hemisphere. This includes California and Mexico, but Dunlins are found around the globe, including Japan and Korea. Some will even stay in Alaska for the winter. They are not found south of the equator. They begin their spring migration north, first ***staging*** (gathering) in large flocks, in late March or early April.

Dunlins have a *circumpolar* breeding distribution, meaning they are found throughout the world in northern tundra areas. In April and May, they arrive at their breeding grounds in the tundra of northern Alaska, Canada, Scandinavia, and Russia. The male performs a courtship song in the air to attract a female and claim a nesting territory. The pair then makes a shallow nest, lined with grass or willow leaves and very hard to see. The female lays four eggs that are greenish with green and brown splotches.



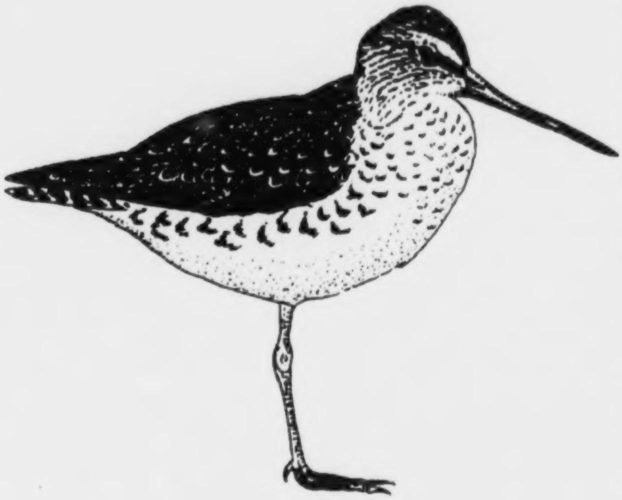
The parents take turns incubating the eggs for 22 days. While one parent is sitting on the nest, the other feeds nearby on spiders, beetles, earth worms, and adult and larval flies. After the chicks hatch, they grow very fast. They ***fledge*** (become able to fly) in about 20 days. Adult birds leave the young and begin flying south in late July to mid-August. The birds take a longer time on their journey south than they did in the spring. Some remain in Alaska until October, or even in southern Alaska all winter. Dunlins stop often at wetlands, especially on coastal or ***estuarine*** (river delta) mudflats, to feed.

Like other shorebirds, Dunlins depend on clean, healthy wetlands for survival. Pollution is killing the life in some wetlands. Oil spills are one type of pollution that affect wetlands. Oil is harmful to birds in several ways. It can kill the tiny animals that shorebirds need for food. If it covers the feathers of shorebirds, the birds can't keep warm and may die from the cold. If birds ingest (accidently eat) oil, they can be poisoned. It is possible that they will then produce fewer eggs, and that their body condition will be deteriorated, making migration harder. What is being done in your area to protect the wetlands from oil spills?



Adult Dunlin in Nonbreeding Plumage

DOWITCHER (*Limnodromus spp.*)



Dowitchers are beautiful shorebirds. Overall they appear rusty-colored, with darkish, brown-spotted backs and a rusty-brown breast and belly. They are larger than Western Sandpipers and Dunlins - closer to the size of a Robin. They have long, black, snipe-like bills and green legs.

There are two species of dowitchers found in North America, the Long-billed Dowitcher and the Short-billed Dowitcher. Guess what one difference between them is? Actually, the bill of the Long-billed Dowitcher is only slightly longer and heavier than that of the Short-billed Dowitcher. Only an expert ***birder*** (person who likes to watch or study birds) can tell them apart by sight.

Their ***calls***, however, are quite different. The Short-billed Dowitcher call, heard during migration and winter, is a soft "tu-tu-tu". The Long-billed Dowitcher call is a high-pitched "keek". Their ***songs*** are different too. Although in general the fancy songs of birds are heard only during their breeding season and on their breeding grounds, you might hear the song of the Long-billed Dowitcher during any time of the year.

Dowitchers on the west coast of the Americas spend the winter from California to Peru. In early March, dowitchers begin migrating northward in small groups. During the flight north, dowitchers fly 2,500 miles at a time without stopping to rest and feed! When they do stop, migrating dowitchers use a variety of inland and coastal wetland habitats.

During migration they feed on worms, clams, snails, and sand fleas. Dowitchers feed using an up and down motion of the head like a sewing machine. Often, they will dip their entire heads into the water. Did you ever see a dowitcher with a muddy face?

Dowitchers nest in open habitat along the Alaskan and Russian coast or inland Canada. Nests are found in muskeg, tundra, and grassy swamps and marshes. The male arrives at the breeding grounds first and chooses a nesting site. He claims his territory and courts the female by hovering over the nesting site and performing a song (the different dowitcher species have their own unique songs).

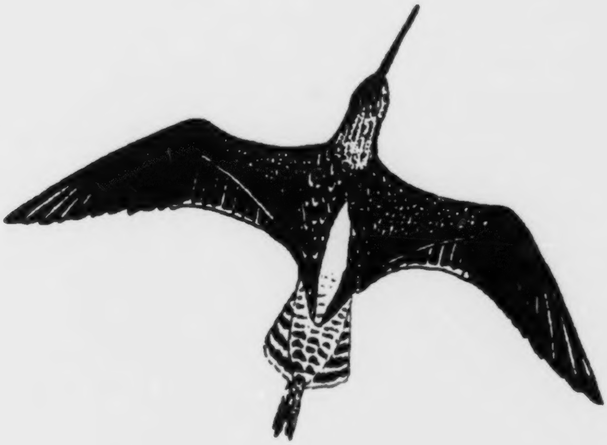
The female helps the male build a nest on the ground with grass and soft moss. Long-billed Dowitcher nests often are in such wet habitat that the bottom of the nests can be wet! The female lays four green eggs spotted with buff. For 21 days, the parents take turns incubating the eggs.

As soon as the chicks hatch from their eggs, the female leaves! She spends a very short time in the Arctic, leaving for the south in late June. The male is left to care for the chicks. Like other shorebirds, dowitcher chicks can walk when they hatch, but they cannot fly for several weeks.

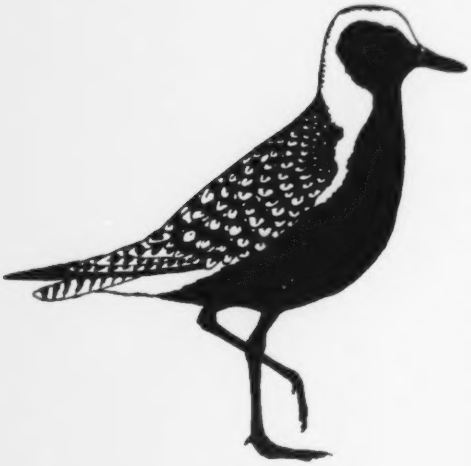
The male protects the chicks from predators. He also shows them how to look for insects, beetles, and the seeds of aquatic plants. When they are a few days old, the chicks begin to exercise their tiny wing muscles by stretching their wings out as they walk. Then they begin to take short, flying steps as they run about looking for food.

As soon as the chicks can fly, the male gathers with other males to begin the flight south. The young birds stay behind and practice flying for another week or so. Like most shorebird species, the dowitcher young are left to find their own way south. It may seem mysterious, but they get there!

Dowitchers were once hunted in great numbers for North American markets. Today, the greatest threat to shorebirds is loss of the wetlands they depend on.



BLACK-BELLIED PLOVER *(Pluvialis squatarola)*

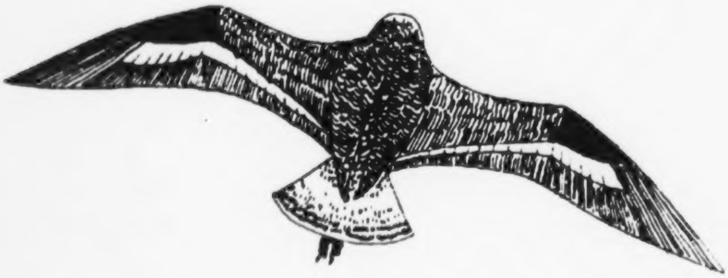


The Black-Bellied Plover is a plump, handsome shorebird. When in its ***breeding plumage***, it has a black and white speckled back with black face, neck and breast. There is white under the tail and a distinct white strip down each side of the neck. Notice how the black of its belly extends all the way to the face, unlike in the Dunlin. The "under arms" (under the wing, close to the body) are always black. The legs and short bill are black too. This plover is also known in Europe as the Grey Plover or Silver Plover.

The call is a loud, sad "tlee-oo-ee", with the second syllable lower in pitch than the first or last. Try to make the call of the Black-bellied Plover!

Black-bellied Plovers of the western United States spend the winter in grasslands and beaches along the coast from British Columbia to Chile. They feed on earthworms, grubs, and beetles they find there.

Like many other shorebirds, these plovers are great long-distance fliers. In mid-April Black-bellied Plovers begin the long flight north to their breeding grounds in the tundra. They fly in small groups along with other kinds of shorebirds. Together, they fly all the way to the coast of the Arctic Ocean.

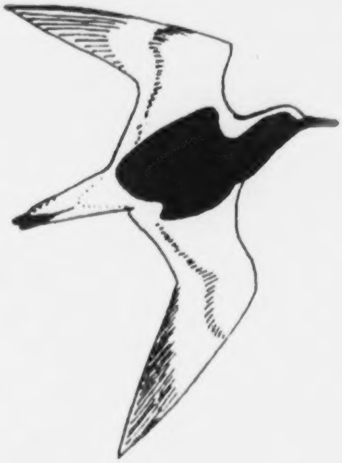


The male chooses a nest site in the tundra on a grassy mound with a good view. He defends the nest site, or ***territory***, against other males and courts the female with a short, zigzag, or "butterfly," flight. The parents work together to build the nest, with the male making the scrape and the female lining it with grasses or lichens. The female lays four pink, green, or brownish eggs with dark spots. The parents take turns incubating for 23 days. Like other shorebirds, they must not be disturbed while they are incubating their eggs, or they may abandon them.

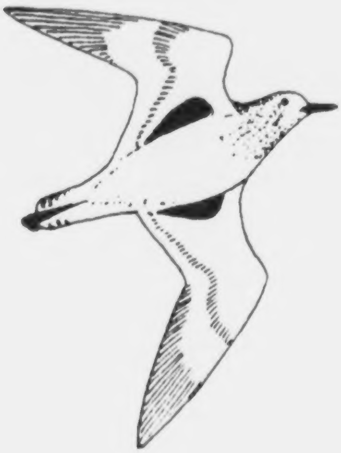
The northern tundra is in the land of the midnight sun. Young birds eat a lot and grow fast in the long daylight hours of summer. Both parents help care for the chicks. They show the chicks how to hunt for insect larvae and beetles.

The long flight south in the fall begins in July or August. The adults go first. As soon as their wing muscles are strong, the young chicks head south too. During their long fall migration, Black-bellied Plovers stop often to feed in wetland areas.

Does your community have healthy, clean wetlands where Black-bellied Plovers and other shorebirds can feed? What can you do to help protect the wetlands from pollution?



Spring/Breeding Plumage



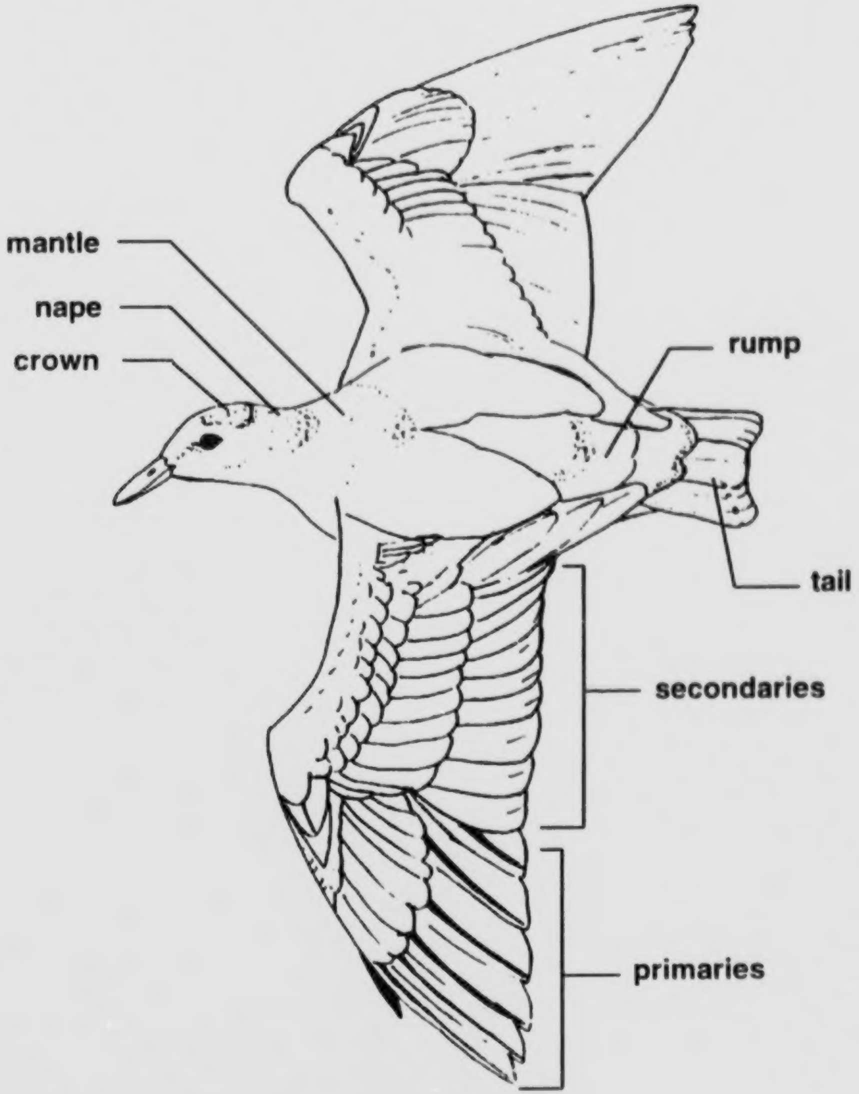
Fall/Nonbreeding Plumage

SHOREBIRD PROFILES: *STUDENT WORKSHEET*

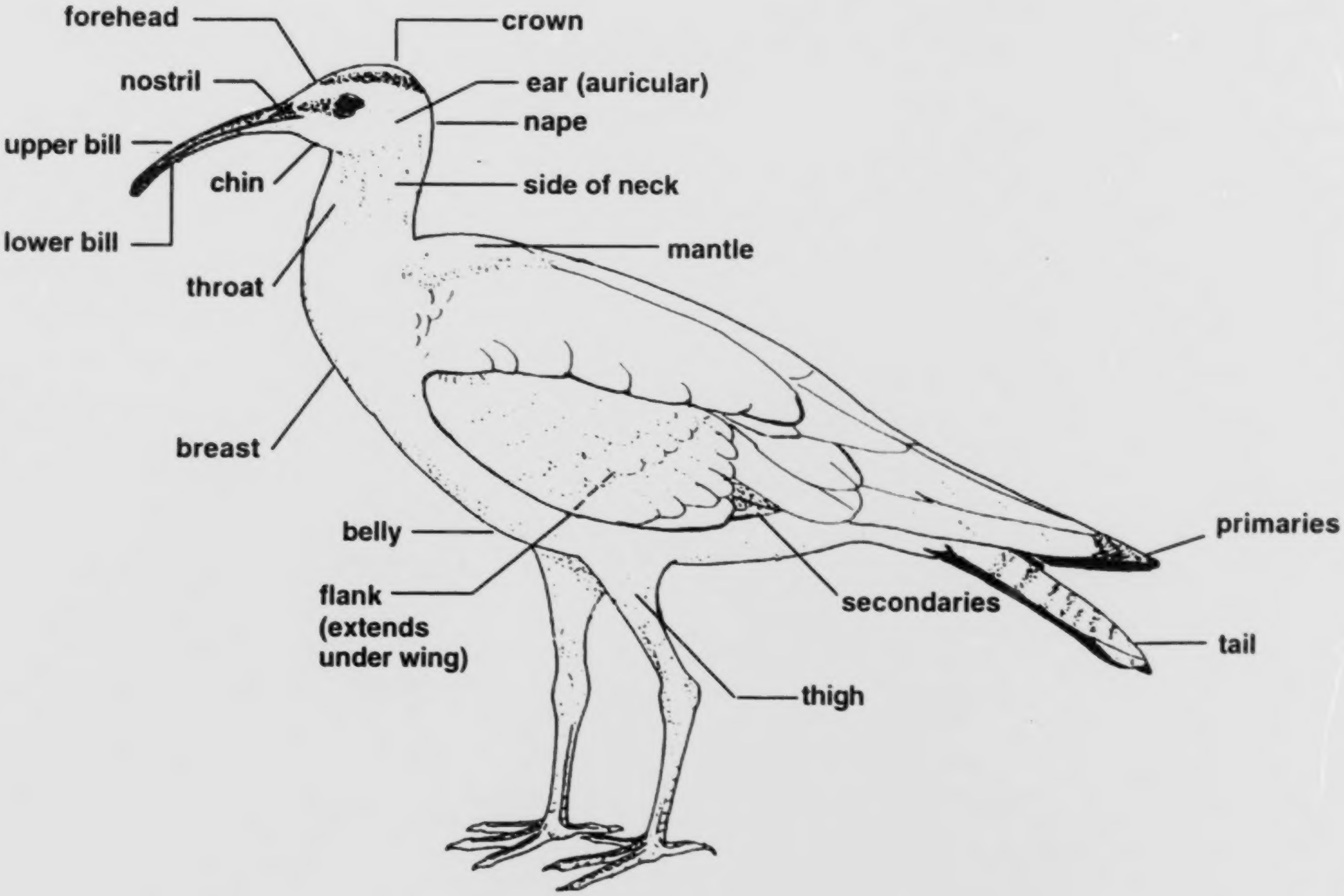
Directions: You have read essays about these shorebirds. Now fill in the table below. Concentrate on making ***direct comparisons*** - what is alike and what is different among the birds?

TRAITS ➡ *SPECIES* ⬇	Physical Description	Food (Note seasons for which food is described.)	Spring Migration (Time and Place)	Mating Behavior (Who does what?)	Most Interesting Thing You Learned
Western Sandpiper					
Dunlin					
Dowitcher					
Black-bellied Plover					

SHOREBIRD MORPHOLOGY: *Flying*

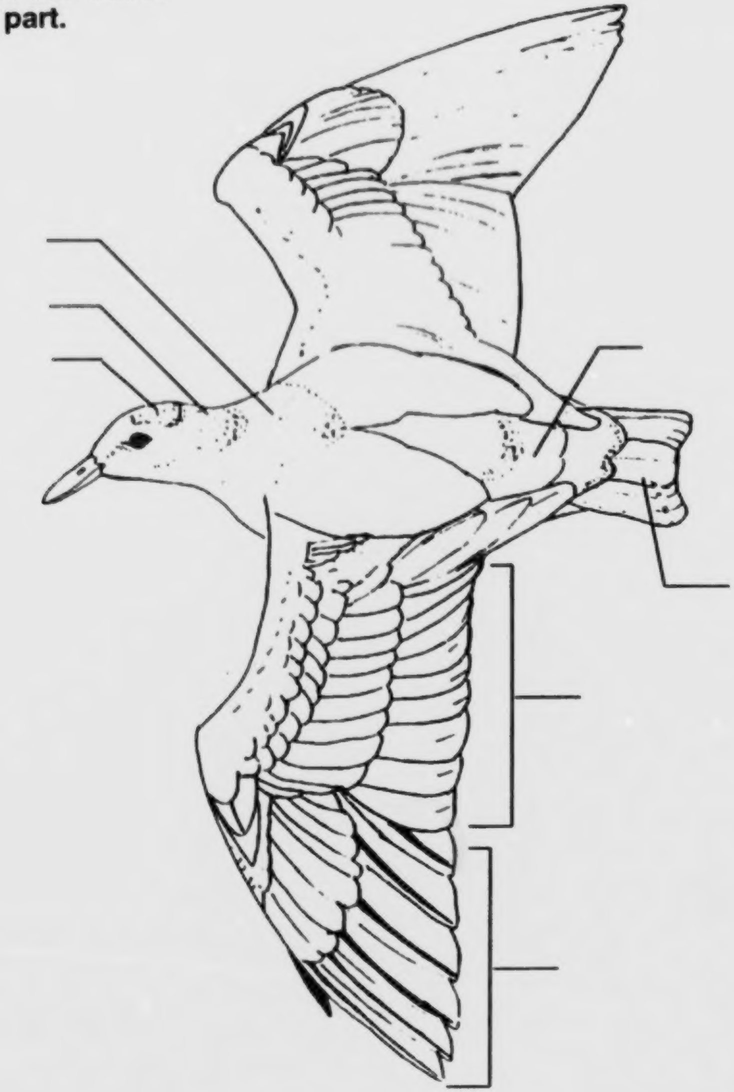

mantle
nape
crown
rump
tail
secondaries
primaries

SHOREBIRD MORPHOLOGY: *Standing*


forehead
crown
nostril
ear (auricular)
nape
upper bill
chin
side of neck
lower bill
mantle
throat
breast
belly
primaries
flank
(extends
under wing)
secondaries
tail
thigh

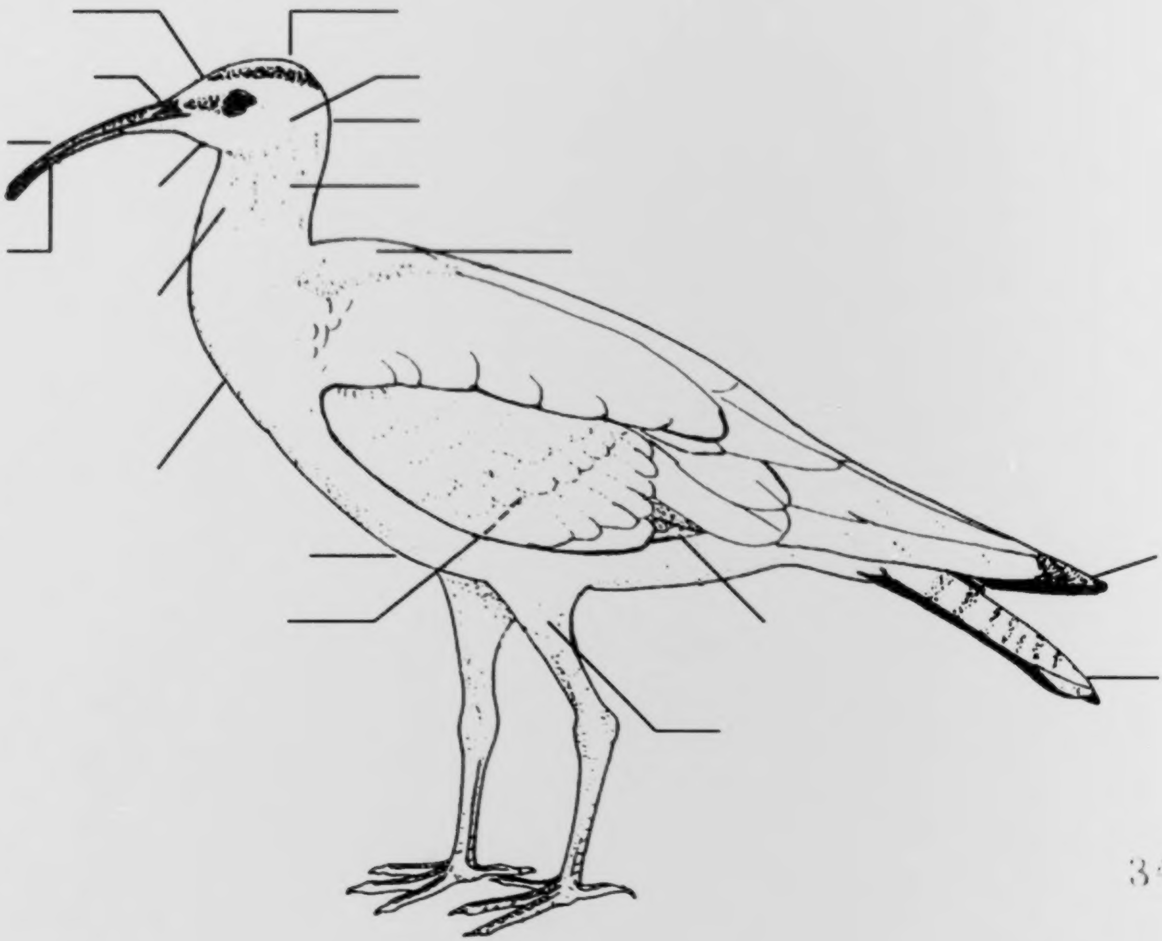
SHOREBIRD MORPHOLOGY: *Flying*

Directions: Fill in the blanks with the names of the correct body part.



SHOREBIRD MORPHOLOGY: *Standing*

Directions: Fill in the blanks with the name of the correct shorebird body part



ADDITIONAL ACTIVITIES: *INTRODUCTION TO SHOREBIRDS*

1. **Coloring Pages. K-9.** You will find several outline drawings of shorebirds in Appendix A. Suggested uses for younger children include a coloring book or making mobiles. For grades 3 and above, these can be used to make flashcards for identification practice or relays. Also facilitate the study of anatomy by reading students descriptions of the birds (e.g., "pink *bill*" or "black stripes on *crown*") and having them color in the birds based on what they hear.

2. **Puppet Shows or Masks. K-6.**

Part 1. Shorebird puppets and a script in either English or Spanish are **available to be checked out** from the External Affairs Branch of the U.S. Fish and Wildlife Service Regional Office in Anchorage, Alaska. Alternatively, have your students make their own paper plate masks or sock, paperbag, felt, or other style shorebird puppets. Assign prizes to the fanciest (most elaborate), best camouflage, most easy to identify (accurate), silliest, best beak, etc.

Part 2. Assign topics to cooperative groups and have them stage puppet shows or plays. Topics could include "Migration", "Habitat" or "Life at the Shore", "Camouflage" or "Long-legs", "Nestbuilding", or "Hatching eggs". Students can also create puppets of themselves and stage plays showing their interactions with shorebirds.

3. **Anatomy and Identification. 3-10.** Make copies of the field guide (*"Shorebird Guide for Kachemak Bay and Homer, Alaska"*) included with this curriculum book. After students have studied general shorebird anatomy, ask them to identify the bird(s) with "black crown stripes", "pinkish legs", etc.

4. **Key Words. 5-12.** Use some or all of the "Key Words" listed at the end of each chapter in several ways, like those that follow here: Conduct spelling bees. Have students use five of the words in a paragraph about shorebirds, or all of the words in a story. Research to compare how the words relate to shorebirds during winter, summer, and spring.

5. **Vocabulary. 6-12.** Have students pick out of the readings (or choose for them) ten general vocabulary words of their own (e.g., grub, latitude, component, or ritual). Have them define these words and use in sentences. To reward thorough work, reward any student who chooses a unique word (unused by other students) of at least two syllables.

6. **Adaptations. 6-12.** Discuss the following as *adaptations*: migration, camouflage, and bill size/shape. What biotic and abiotic elements in the environment may have affected the development of these strategies? What other strategies might work?

KEY WORDS: *INTRODUCTION TO SHOREBIRDS*

abiotic
Arctic
behavior
call
diversity
ecosystem
flock
food chain/food pyramid/food web
guano
Holarctic
hypothesis(es)
indicator species
migration
morphology
Nearctic
Palearctic
phytoplankton
plumage
shore
shorebird
song
territory
tundra
wetland

ADAPTATIONS

CONCEPTS:

- **Shorebirds have many physical, or *morphological*, adaptations to help them walk, find food, and reproduce in their habitat, and to fly long distances during migration.**
- **Shorebirds are also adapted *physiologically* to their migrating lifestyle, particularly in their fat-loading abilities which enable them to maintain energy for their long flights.**
- **Adaptations are naturally selected for over a long period of time, and specialized animals like shorebirds cannot adapt overnight to damage or alteration of their habitat.**

SHOREBIRD ADAPTATIONS

One definition of ***species*** is a group of ***organisms*** (lifeforms) that can breed and produce fertile offspring. In other words, bulldogs and collies belong to the same species (dog) because they can mate and produce puppies which can grow up and have their own puppies. Another, perhaps easier to picture, definition of species is a group of organisms which have similar physical traits. All dogs are mammals with a certain type of teeth, skull structure, etc. Different species have different physical ***traits***, or characteristics.

These traits help a plant or animal (or other organism) use particular resources found in their habitat for food and reproduction. A habitat is the environment in which an organism lives, its "home". You will learn more about shorebird habitat later. Say an individual bird is born with a trait which differs slightly from other members of its species. If that trait gives it an ***advantage*** (extra boost or help as compared to what other individuals of the species have) in *surviving to* ***breed*** (reproduce), the bird may successfully pass on the genes for that trait. The trait may persist in the species as long as it gives the bird an advantage, or at least the possibility of ***competition***, in its environment.

Helpful traits are called ***adaptations*** because they help an organism ***compete*** (perform as well or better as other individuals in such actions as surviving to breed) in its particular environment. The Theory of ***Natural Selection*** explains this process. If something in the organism's environment changes, say the climate or a food source, the old trait may not be as helpful as another adaptation. Perhaps the organism will eventually not survive to pass on its genes.

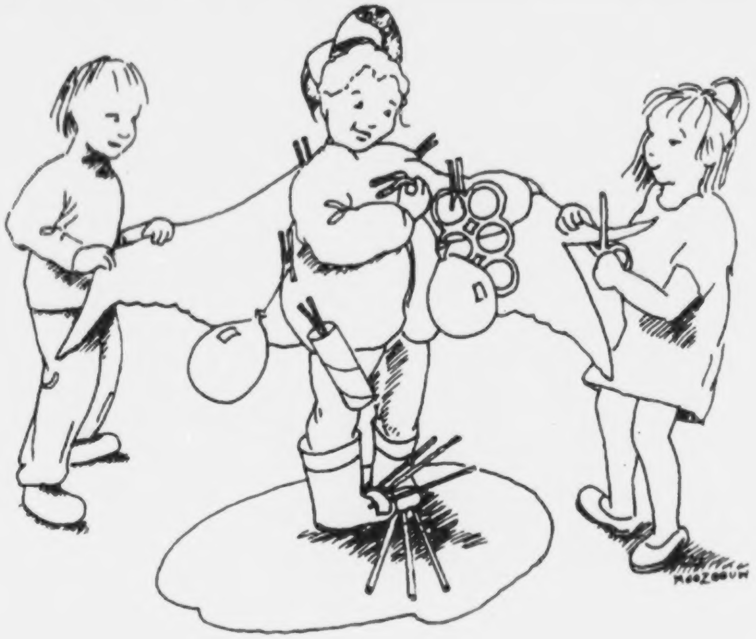
Shorebirds are birds with adaptations to help them survive in the environment of the shore or other open wetlands. Some of these adaptations include: plumage that conceals chicks and adults from predators (it is the color of the shore or speckled like the tundra), long legs for wading, and bill shapes that help them probe for buried food items. Other adaptations are behavioral, such as parents distracting intruders away from their nests.

Although adaptations may be physical or behavioral, the activities in this section will focus primarily on physical traits of shorebirds. Physical adaptations have to do with an organism's morphology, physiology or both. ***Morphology*** refers to external *anatomy*, or the *form* and appearance of an organism. ***Physiology*** refers to the bodily *functions*, like reproduction or digestion, of the organism.

You will find behavioral adaptations like migrating and nest defense explored in later sections. Of course, many behavioral and physical adaptations are very closely entwined! For instance, the shape of a shorebird's bill affects the way it uses it, or is it the other way around?! Also, if a shorebird chick's defense is camouflage (a physical adaptation), will it be more likely to behave in a way that conceals or draws attention to itself? We don't know all the answers yet, but science is all about discovery!

- Activity -

BUILD A SHOREBIRD



Grade level: 2 - 9

Objectives: Learn about physical adaptations that are unique to birds by transforming a volunteer into a bird. Learn about adaptations that are unique to shorebirds by then transforming the volunteer into a shorebird. Explore the diversity of shorebirds and their niches. Explore some of the threats to shorebird survival.

Duration: One 40 to 60-minute class period.

Materials:

Flash cards (Appendix B)
Down jacket or vest
Picture of comparison between
  down and contour feathers
2 large paper bird wings
Several drinking straws or cardboard
  toilet paper rolls
Chicken bone
Balloons
Camouflage-patterned hat, vest, or cloth
Scissors
Spray bottle
Duct tape

Cardboard bill, or tweezers tied on a string necklace
Cardboard or paper bottle of baby oil
"M & Ms" or "Gummy Worms"
Popcorn
String (20 - 40 feet)
Black paper oil splashes
Blue paper wetland
6-pack rings or a net
Clothespins

Optional: *Electric fan*
Rubber boots or waders

Teacher Preparation:

1. After gathering materials, students or teacher need to construct one student-sized set of paper wings, which will be cut and modified during the activity; one blue paper wetland to stand on; one cardboard bill; one paper bottle of baby oil; and several black construction paper cut-outs of oil spills.

2. Create flashcards in three different colors: "General Bird Adaptation" cards can be yellow. They give the name of the adaptation on one side, and a description on the other. "Special Shorebird Adaptation" cards are blue. "Threat to Shorebird" cards are red. You can use the masters found in Appendix B. There should be enough cards so that every student besides the bird volunteer has at least one. For large classes, duplicate cards are fine.

Procedure:

1. Discuss and define ***adaptation*** (characteristic or behavior that helps an organism survive in its environment). Explain that the aim of this activity is to explore the world of shorebirds and examine adaptations by building a shorebird.

2. Ask for a volunteer. This person will be turned first into a bird, then into a shorebird, and finally into a Western Sandpiper. He/she will also be subjected to some threats a shorebird may face (the volunteer must have a strong constitution!).

3. Distribute all the flash cards to students to prompt their involvement in the activity.

4. Begin building a bird. Start with the yellow cards. See the chart on the following pages for adaptations. Use the clothespins to attach most items to the student.

GENERAL BIRD ADAPTATIONS (YELLOW CARDS)		
ADAPTATION	**DESCRIPTION**	**MATERIAL NEEDED**
1. Down Feathers Ask students to imagine they are birds in flight. Ask how it feels to be soaring above the earth. Is it cold? Skin isn't enough to insulate you up there. You have had to adapt to temperature extremes. How? With feathers.	Feathers are a unique adaptation found only in birds. Two kinds of feathers are found on all birds: 1) *Down* feathers - fluffy, under-feathers for insulation. These are the bird's underwear. 2) *Contour* feathers - strong outer feathers for flight. These are also the bird's clothes and coloration.	Dress bird in **down jacket** and **bird wings**. Study **comparison pictures of down and contour feathers.**
2. Contour Feathers What sort of material is strong and flexible enough for the wings and tail to help you fly?		
3. Hollow bones Ask students to think about how much they weigh. Then ask how much they think a Bald Eagle weighs. It only weighs between 8 - 14 lbs and has a 7 - 8 ft wing span.	Hollow bones help a bird keep its weight low. Most of the bird's weight is in the breast and wings (where the flight muscles are). Our bones are not hollow, but instead are filled with marrow for red blood cell production. Birds have marrow only in their breast bone *(sternum).*	Attach **drinking straw** or **cardboard paper roll** to down jacket. Pass **chicken bone** around for the students to examine its weight and structure.
4. Air sacs Ask a volunteer to stand up and become a crow by flapping his/her wings 20 times in 10 seconds. Ask how much effort that was on his/her breathing. Harder than walking? Yes!	Air sacs enable a bird to take in enough oxygen to help transfer energy into a usable form for flight. Birds have lungs like humans, but they require more oxygen intake. Air sacs, rather like balloons, extend from the lungs and between, and into, hollow bones. During inhalation and exhalation air flows through the lungs and the air sacs to maximize the absorption of oxygen.	Attach **balloons** with clothespins: each student with a yellow card places one balloon on the bird.

5. Our volunteer has been turned into a bird, and now this bird will become a shorebird. Explain that shorebirds are birds of open spaces which fly long distances (migrate) to spend their winter ("nonbreeding" season) on beaches, mudflats, and estuaries (the "shore").

SPECIAL SHOREBIRD ADAPTATIONS (BLUE FLASH CARDS)		
ADAPTATION	**DESCRIPTION**	**MATERIAL NEEDED**
5. Long, pointed wings Ask students to think about the different shape of bird's wings. Compare the stubby wings of a penguin to the big, broad wings of a soaring eagle. Do you think that wing shape might be related to what the bird uses them for (lifestyle)?	The shorebird way of life includes flying long distances between the summer home where it breeds, to shores where it spends the rest of the year just feeding and avoiding the cold weather of the higher latitudes ("North" in the Northern Hemisphere). This is called *migration*. In order to fly fast and far, having long, pointed wings is helpful.	Use the **scissors** to shape the tip of the volunteer's paper wings so that they look long and pointed.
6. Camouflage Plumage Ask students to think about how a small bird can protect itself from larger predators. Would small shorebirds have much luck *fighting* with hawks on the beach or with foxes on the tundra?	*Cryptic coloration*, or *camouflage* helps these birds be less conspicuous. Because they spend much of their time on mudflats, beaches, or grassy tundra, their *plumage* is generally shades of brown, black, white, or russet which blends in with their habitat. (Larger shorebirds, like Avocets and Oystercatchers, can't hide as easily, and therefore don't generally bother with camouflage.)	Place the **camouflage clothing** on the bird.
7. Long Legs Ask students if they would need big legs to sit in a tree or fly. Do they need them to walk? How about running from the waves? Next ask students what adaptation humans use to walk and work in wet conditions.	Shorebirds seldom perch in trees, but rather walk or roost on the ground when they are not flying. Many shorebirds walk on shorelines or mud to find food. Having long legs helps them to wade through water or mud. (Actually, the length of the legs of a shorebird gives a clue to where it feeds.)	Place the **blue material** representing a wetland on the ground for the shorebird to walk on. Optional: Put the **rubber boots/ waders** on the bird.

8. Long Toes What are your toes for? Toes are for stability in walking.	Shorebirds do not spend much time swimming like seabirds do. Therefore, they don't need webbed feet, just long toes for stability and walking.	Using duct tape, attach three long **drinking straws** to each toe of the bird.
9. Bill Ask students what humans use to feed themselves (forks, straws, chopsticks, fingers, lips, teeth, etc.). Do you use different things to help you eat different foods?	Bills, or beaks, are used for picking up food, nest construction, and courtship, as well as preening and defense. Compare the bills of some shorebirds and explain the different feeding niches the birds fit into. For example: Curlews *probe* deeply into the ground with their long, curved bills to reach buried invertebrates. Plovers and Surfbirds have short, stout bills to *pick* up prey they spot on the surface of sand or rocks. Sanderlings have tapering, tweezer-like bills to help them "stitch" the sand - a rapid, repeated probing to pull up worms and crustaceans right below the surface of the beach.	Attach a **cardboard bill** to the volunteer bird. Alternatively, tie **tweezers** on a string necklace around the neck of the bird to represent the shorebird's bill. Place **"Gummy worms"** in the mouth of the volunteer. These represent the segmented worms or the long, stretchy Nemertean worms that some sandpipers like to eat. May also feed to the bird **M & Ms** or other candy-coated treat, representing crunchy-coated crustaceans.
10. Oil gland Pour oil (cooking or other oil that is different color than water) and water into a beaker and observe the separation. Does oil get wet? What does "get wet" mean? "Wet" means saturated with water. Ask students how they keep dry in the rain. Is raingear treated with any special coating? Yes!	The oil gland helps keep a shorebird's feathers waterproof. Seabirds have oil glands too. Feathers are kept clean and smooth by constant preening with oil from the oil gland found above the base of the tail. The oil is transferred to the plumage (feathers) with the bill or back of head.	Attach the **baby oil bottle** to the back of the down jacket. Ask the bird to try and preen!

6. Shorebirds are adapted for a lot of walking and running, but they have to rest those feet sometime! Have the volunteer **stand on one foot**, just like a roosting shorebird.

7. Spray the volunteer lightly with the **water spray bottle**. Our bird is now a wetland-loving shorebird. Discuss the special adaptations of shorebirds as you use the blue flash cards to transform the volunteer.

8. Now discuss the importance of shorebird scat (*guano*). What goes in must come out! Sprinkle the **popcorn** around the volunteer shorebird. Guano from shorebirds, just as from other birds and bats, contributes to the chain of life. Nutrients from guano are returned to the wetlands that the shorebird uses. The (elemental and molecular) nutrients in guano are made available for manufacture of food by tiny plants and plankton. These "food makers" (photosynthesizers) become food in turn for small fish, crustaceans, and other animals. The *food web* is continued, and eventually it includes the shorebirds and even humans. Every organism and its activities plays a part in the chain of life on our planet.

9. Our volunteer shorebird will now become a Western Sandpiper in a huge flock. Western Sandpipers are very small, Arctic-nesting shorebirds with a rufous or chestnut color to their speckled backs. They are familiar to many people because of the huge flocks they form during migration. The teacher **selects a few students to join the volunteer shorebird**, perhaps holding hands, as members of a Western Sandpiper flock. Western Sandpipers could be chosen based on who is wearing a reddish shirt or the four smallest students, etc..

Alternatively, the volunteer shorebird could become a Dunlin, another flocking Arctic nesting shorebird with a striking black breast during breeding season. Students with black on the front of their shirts could join the flock as other Dunlin.

10. Now we will explore why life is not easy for a shorebird. In addition to the difficulties of migrating long distances over the ocean or in bad weather, shorebirds are also subject to human-caused dangers. ***Market-hunting*** for shorebirds killed them by the millions in the past. Shorebirds are no longer killed to be sold as food, but other threats have grown significantly. ***Habitat loss*** is the biggest threat to shorebird survival today. Discuss this threat and others listed below, while referring students to red flash cards.

THREATS TO SHOREBIRDS (RED CARDS)		
THREAT	**DESCRIPTION**	**MATERIAL NEEDED**
11. Habitat destruction Discuss the terms ***"estuary"*** and ***"wetlands"***. Ask students about any places where they see shorebirds locally. What kind of place is it? Is there any threat of it being destroyed? If there is not a local concentration of shorebirds, another well-known local animal can be substituted for discussion.	"Habitat" is where something lives. In any year, most shorebirds depend on at least three habitats: breeding, nonbreeding, and migration sites. Most important migratory stopovers for Arctic-nesting shorebirds are estuaries or other types of wetlands. These fragile areas are also very attractive to humans as water sources or home sites. Water is drained away or its course altered, and bridges, houses, and docks are built. Animals and plants which provide food and shelter for the shorebirds are destroyed.	Restrict the habitat available to the shorebird flock by penning them in with **desks**, or winding **string** around the student birds to tie them together. Now say "all the shorebirds with habitat get Gummy Worms!", and pass out treats to those in the habitat. What about everyone else? Ask them "Can we make new habitat. How about fixing ruined habitat?". Ask for ideas.

44

12. Oil contamination	Oil spills can be very damaging to estuaries. Devastating oil spills, killing shorebirds and destroying habitat for many years, have occurred in many places in the world when oil tankers were disabled near shores.	Pin **oil splashes** on the volunteer shorebirds.
13. Disturbance Ask students how disturbing a shorebird or flock could harm it or its young.	When the seasons change, flocks must migrate very quickly, either to take advantage of the short Arctic summer to breed, or to avoid the coming cold of winter in the North. If flocks are disturbed and cannot refuel with food at their traditional stopover points, they may not have another chance to find enough food for the journey. Planes and people approaching can also disturb shorebirds on their nests, exposing eggs and chicks to predators and the weather.	Have the students make noise to simulate ATVs or motorcycles. Alternatively, turn the **electric fan** on and point it towards the flock to simulate a disturbance.
14. Trash on the beach or in other wetlands Ask students if they have ever seen trash littering their local wetlands. Where did it come from? What should have been done with it? Besides cutting down on the use of "disposable" trash and putting trash in its place, one should also cut up plastic rings or long strings before throwing it away. Never leave tangled fishline behind in the water or on the shore, and cut it into small pieces before disposing of it in the trash.	Plastic debris and other trash can be mistaken for food by birds, and can kill them. Shorebirds can also become entangled in discarded fishline and 6-pack rings. Abandoned cars, appliances, and other trash items can leak poisons into wetlands. What sort of message do people get when they see trash? Seeing trash on the beach can give children and visitors the impression that the land is not valued, or teach them that it's ok to discard more trash.	Place **netting** or **plastic 6-pack rings** somewhere on the sandpipers.

11. Summarize the key points of the activity with a **quick quiz**:

What makes a bird a bird? Describe three unique ***adaptations*** of birds.
- Feathers
- Hollow bones
- Air sacs

Describe three special ***adaptations*** of shorebirds.
- Camouflage plumage
- Long, pointed wings
- Legs for walking, wading, and running
- ***Bill*** for probing or picking

Why are shorebirds important?
- Add ***diversity*** to shore life
- Important part of *food web*, including prey for raptors and fertilization of wetlands

What is the most significant threat to shorebirds today?
- Habitat alteration or loss

Name two other human-related activities that can be harmful to shorebirds
- Oil contamination (oil spills)
- Contamination from other dumped chemicals
- Trash
- Scaring birds from their nests
- Scaring birds from their feeding and resting spots during migration
- (Market-hunting in the past)

12. A **final thought**: The next time you see a shorebird, look for the unique traits that have helped adapt it to its way of life, and ponder its importance in the "web of life".

Adapted from *Learn About Seabirds*.

- Activity -

WHAT CAN I EAT WITH THIS BEAK?

Grade level: 2 - 8

Objectives: Learn that birds' beaks are adapted to the foods they eat. Learn that because different birds have different feeding behaviors and habits, several types of birds may live in the same habitat at the same time. Learn that living things are dependent on their environment for survival. Explore the relationship between "form" and "function." Practice the critical thinking skills of comparison, evaluation, and problem solving.

Duration: One 40-minute class period.

Materials (for a group of 30):

Bird stomachs: 1 paper cup per student

Food items: 50 marbles (snails)
100 toothpicks or cut pipe cleaners (worms)
100 3/16" metal washers or similar (crustaceans)

Beaks: 7 spoons
7 pair scissors
8 pair tweezers
8 spring type clothespins

Chalkboard/ easel paper
Bird poster or bird beak chart

Older students:
copies of worksheet/data sheets (included)

Procedure:

1. Discuss with students that there are many different kinds of beak adaptations which relate to the foods that birds eat. What kinds of beaks have they seen? Show examples of beaks by using pictures, study skins, masks, or puppets.

2. Hold up the beak utensils one at a time and ask the students for examples of birds that have beaks similar to the utensil.

3. After the discussion about bird beaks, introduce students to the activity by having them imagine that they are a flock of shorebirds.

4. Have students count off in 4's, with the "ones" being spoon-beaks, the "twos" being scissor-beaks, etc. Hand one stomach and one bird beak to each player.

5. Explain the rules: The birds must pick up food using only their beaks and then drop the food into their stomachs. Food may not be scooped or thrown into the stomach, and the stomach must be held upright. The teacher is a hawk that eats birds. Unruly behavior or violation of rules result in the hawk capturing the conspicuous bird and making it sit out for one round. (Unusual behavior of a bird draws attention from a predator which will eat it.)

6. Have students sit in a large circle (their habitat). The leader distributes one food type inside the circle and gives the signal to start feeding. Feeding may occur only when a signal is given. The leader may choose to do this by telling the birds (students) that it is night (lights out) and the birds are asleep. Then turn on the lights and let them feed for a short time (up to 2 minutes). When ready to have all birds stop feeding, turn off the lights as if the sun set.

7. Have similar beak-types get together and count the combined number of food items collected. Record the data, perhaps on one large paper for the entire class to see. Older students can record averages.

8. Repeat steps 6 and 7 for each type of food.

9. Next, mix all three food types and let the birds gather food. This is a more natural situation. An area seldom has only one type of food. Record the data. The birds should first eat the food they can gather the easiest (as discovered in the earlier rounds), and then switch to a secondary food item as it gets harder to gather their first choice.

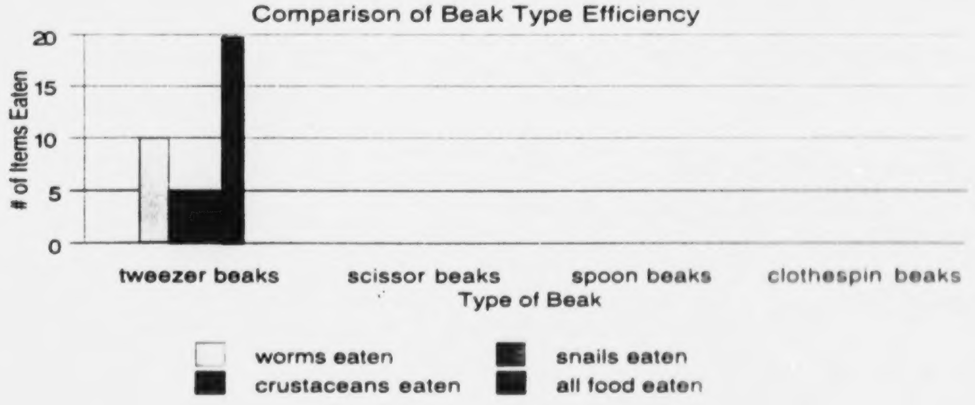
Extensions:

10. Afterwards, a class discussion may include the questions listed on the following student pages.

11. Have students do research contrasting the shorebird feeding techniques of "probing" and "picking".

12. Have students look at bird guides and pictures to find other beak types besides the four involved here. Students can guess what these birds might eat. Older students can do follow-up research and write or present a comparison between their guess and the facts they discovered. They can also consider bill length and its relation to prey items. Younger students can draw imaginary bird beak creations of their own, and show in the drawing or describe with words what their bird eats and how its beak is adapted to its food.

13. An additional graphing exercise is suggested below.



Adapted from Johnston, et. al., Salt Marsh Manual: An Educator's Guide. Activity development funded by the Environmental License Plate Fund, California Department of Education.

- Activity -

WHAT CAN I EAT WITH THIS BEAK? *STUDENT WORKSHEET*

Background: Living in the mudflats are hundreds of different species of organisms that shorebirds will eat. These include worms, clams, snails, and crustaceans. Birds have different types of beaks that allow them to eat different kinds of prey items. Their beaks, also called bills, are adapted to match their food types.

Many shorebirds have tweezer-like beaks. A bird with a "short tweezer" beak will take food near the surface of the mud, while a "long tweezer" beak can reach animals that burrow deeper. Some birds, like eagles and owls, have tearing scissor-like beaks which rip their food apart into bite-sized pieces. Other birds have beaks which crush like a clothespin, and so are excellent for breaking the hard covering of seeds. Chickadees and Pine Grosbeaks are two clothespin-beaked forest birds. The oystercatcher, a type of shorebird, has a beak that *looks* like a red clothespin, but uses it in a way very different from seed-eaters. Oystercatchers pry mussels open and chisel limpets off rocks. Some birds have spoon-like beaks which can scoop up lots of small fish or strain plant material from the mud. Have you ever seen a Northern Shoveler or a Mallard duck do this?

Since birds eat different types of food, or at different places within a habitat, different species can all live in the same habitat at the same time (coexist). This is why you see many types of birds feeding together in one area. What other beak types can you think of besides the four we have considered in this activity?

Procedure:

1. Follow your teacher's instructions to do the food collecting activity with your class and record your findings on the data sheet.

What Can I Eat With This Beak?

DATA SHEET

	Food Items			
Beak Type	Worms	Snails	Crustaceans	All Food Types
Tweezer				
Scissors				
Spoon				
Clothespin				

2. Discuss the following questions in class:

   A. Are some beaks better at getting a particular food item than other beaks?

   B. How does the ***feeding success*** (measured as number of items captured, or number of items per minute) change for each beak type as the food changes?

   C. Some birds eat food that lives in mud, some find food in water, and others eat plants. In which habitat does each beak type forage for its food?

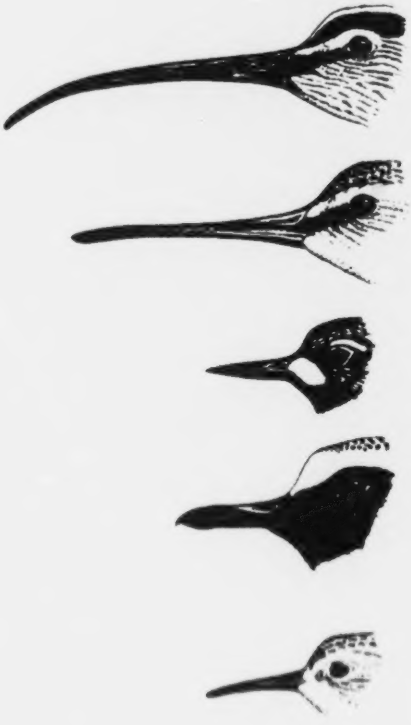
   D. Can you think of any other beak types besides the four we studied in this activity?

   E. Does having a different-shaped beak cause a bird to use it differently?

   F. Which beak types do shorebirds have? Which beak types do shorebirds not have? Why?

   G. What other parts of the bird, besides its beak, are important to its feeding success? (hint: webbed or differently-shaped feet, length of neck, length of legs, etc.)

   H. What differences do you detect in the feeding behavior of the birds when all food items are available at once? (hint: more fighting or more relaxed and less fighting?)



Some Shorebird Beak Types

- Activity -

AVIAN OLYMPICS

Grade level: 6 - 9

Objectives: By competing in physical and math/science activities, learn that birds have some incredible physical abilities. Learn that birds need these abilities to successfully migrate long distances. Be able to describe some of these physical abilities. Learn that migration is an essential, annual part of the life of a shorebird. Learn why individual birds may not survive a difficult migration. Explore the relationship between calories, fat, and energy. Practice working with others in cooperative groups. Practice math, stopwatch, mapping, and laboratory weighing skills. Practice making comparisons. Practice use of the metric system.

Duration: One to three 40-minute class periods. (Activity can be continued for short periods on several days if desired.)

Materials:
Triple-beam balance or other scale, for use in Step 2, below
Clock with second hand visible to entire room, or one stop watch per group
World map with kilometer scale
Student worksheet (included)
50 meter track or running area

Procedure:

1. Form Teams:

a. Divide the class into cooperative groups of 3 to 6 students. Groups will compete against each other in problem-solving, math skills, speed, and endurance. Each team selects a mascot migratory shorebird group, such as plovers, oystercatchers, sandpipers, curlews, turnstones, godwits, and phalaropes. The object of each team is to get the most possible points. You may wish to shorten or lengthen the lesson by awarding points to only certain answers, and doing the other calculations as a class.

b. Hand out a copy of the student worksheet to each group.

2. Weigh-in:

a. The average middle school student's weight is 100 lbs or 45 kg. Ask students how many grams are in 45 kg.
Answer: 45,000 g

b. Compare that weight to the weight of the Western Sandpiper which weighs about 25 grams (less than 1 oz). Have the teams try to find an object in the classroom that weighs 25 grams. Test their entries with a triple-beam balance. If no team is close, give them all a second chance to see how close they can get with different objects. The team that is closest earns one point.

c. Have each team, working together, calculate how many Western Sandpipers (at 25 grams) it would take to equal the weight of an average middle school student (at 45 kg). The group that does this the fastest earns one point.
Answer: 45,000 g ÷ 25 g = 1,800 Western Sandpipers

3. Eating like a bird (Fat-loading):

This is a math contest, and all students on each team should work as a cooperative group to find the answers. Tell the class that when a team gets the answer (to "b", "c", and "d"), they should raise their hands. Ensure communication among the team members by telling them that the teacher will call on any member of the team that s/he chooses for the answer.

a. One quarter-pound hamburger and fries is an average-sized meal for a student of this size. Two or three burgers would be a huge meal. What's the largest number of quarter-pound hamburgers any of the students has ever eaten in a single meal?

b. What percentage of the average weight of a middle school student is this? (Assume a quarter-pound hamburger = 114 grams.) The first group with the correct answer gets one point.
Example answer: If 3 is the number of quarter-pounders:
3 burgers x 114 g (burger weight) = 342 g
342 g ÷ 45,000 g (student weight) = 0.76%, or less than 1%

c. Compare this with the Golden Plover, which gains enough fat to increase its body weight by almost 30% for its migration from Hawaii to Alaska. If an average student weighing 45 kg were going to increase his/her body weight by 30%, how much weight would s/he gain? The first group with the correct answer gets one point.
Answer: 45 kg (student wt) x .30 = 13.50 kg or 13,500g

d. How many quarter-pound hamburgers is this equal to?
Answer: 13,500 g ÷ 114 g (hamburger wt) = 118 burgers

4. Fast travel:

a. With each team entering its fastest runner, have a 50-meter dash to determine how long it takes a student to sprint 50 meters. The group with the fastest sprinter gets a point.

b. Calculate how long it would take this runner to cover 1 km.
Example answer: If a student runs 50 meters in 15 seconds,

$$\frac{15 \text{ seconds}}{50 \text{ meters}} \text{ x } \frac{X \text{ seconds}}{1{,}000 \text{ meters}}$$

$$15{,}000 = 50X \qquad \frac{15{,}000}{50} = X \text{ seconds} = 300 \text{ seconds}$$

300 seconds ÷ 60 = 5 minutes to cover 1,000 meters

c. Then, using a map of the world, have students estimate the distance in kilometers from their school to Lima, Peru. Using the two measurements, have students calculate how long it would take the fastest student to sprint directly to Lima, assuming s/he could run in a straight line without stopping. Give a point to the team with the first correct answer.
Example answer: 60 minutes ÷ 5 min/km = 12 km/hour
7,500 km ÷ 12 km/hour = 625 hours, or
625 hours ÷ 24 hours/day = 26 days

Compare these results with Sanderlings, which are able to migrate 7,500 km (4,650 miles) between Oregon and Peru in 230 hours, or about 10 days.

5. Wing-flapping:

Have each team select a representative. Using a clock with a second hand, each team determines the highest number of arm flaps possible in 10 seconds.

a. Give a point to the group whose representative flapped the fastest (=most times per 10 seconds).

b. Using the time from the Fast travel event "4c" above, calculate how many arm flaps a student would make in a "flight" to Peru.
Example answer: For 11 flaps in 10 seconds,

$$\frac{\text{11 flaps}}{\text{10 seconds}} = \text{1.1 flaps per second}$$

$$\frac{\text{1.1 flaps}}{\text{1 second}} \times \frac{\text{60 seconds}}{\text{1 minute}} \times \frac{\text{60 minutes}}{\text{1 hour}} \times \frac{\text{24 hours}}{\text{1 day}} = \text{95,040 flaps per day}$$

95,040 flaps x 26 days = 2,471,040 flaps

c. *Advanced work:* Ask students what *assumptions* we are making to get answer "5b", and discuss why the answer might not be accurate. Students may suggest that we are comparing "flaps" (*flying*) with a *running* time. They may also note that we are (probably) using two different students, the one who ran fastest in the class and the one who flapped for each group. To do the calculations in "5b," we are assuming that whether students flap or run, they will cover the distance in the same amount of time. We are also assuming that all students will cover the distance in the same amount of time, or that differences between individuals of the same species are negligible. In science, it is important not to "compare apples to oranges," and to be aware of all assumptions made.

6. Non-stop travel:

a. Which student can continue flapping his/her arms the *longest*? Give that student's team a point. How does this feat compare with the American Golden Plover which flies non-stop for 48 hours as it migrates from Nova Scotia to South America? The Pacific Golden Plover and some curlews and tattlers fly non-stop for 2 to 3 days from Hawaii and other Pacific Islands to Alaska.

b. Discuss how *far* the class thinks the best runner of middle school age can run without stopping. How does this compare with some plovers, curlews and tattlers which fly non-stop from Hawaii and other Pacific Islands to Alaska, a distance of over 3,500 miles? The little Western Sandpiper flies over 250 miles per day between stop-over points along the Pacific coast flyway to Alaska.

7. Long-distance travel:

Have each team identify which of its members has lived farthest from his/her current home. Figure out how many kilometers away that is on a map. The group with a representative from the farthest away gets a point. Give another point to the group that calculates the kilometer distance for its representative the quickest. How does this compare with Sanderlings that fly over 11,000 km twice a year from their high-Arctic breeding grounds to nonbreeding ("wintering") grounds in Peru?

8. Fuel-efficiency:

a. Humans burn about 60 calories by running one kilometer. At this rate, how many calories would a student need to run from here to Peru? A point goes to the group that makes the correct calculation first.

Answer: Use a map to determine how many kilometers from your town to Lima, Peru, and multiply this number by 60 calories.

Example: 60 calories x 7,500 km = 450,000 calories

b. If one gram of fat yields 9 calories of heat, how many kilograms of fat would this student need to eat before making the trip?

Example answer: 450,000 calories ÷ 9 calories/g = 50,000 g

50,000 g ÷ 1,000 = 50 kg

c. Compare this with the Golden Plover, which can travel 3,900 kilometers (2,400 miles) in 48 continuous hours of flying using less than 60 grams (2.1 oz) of body fat. Does this bird burn a lot of calories per kilometer or few calories per kilometer?

9. Assessment:

Provide a reward to the team with the most points. Alternatively, give each group the number of points it earned or a set number of points, plus five extra points to the members of the winning team.

Adapted from Gilchrist et. al., One Bird: Two Habitats.

AVIAN OLYMPICS: *STUDENT WORKSHEET*

Directions:

Answer the following questions one at a time. Do not proceed to the next question until your teacher has given the class the direction to do so. Show all calculations. (Hint for math problems: Carrying *units* through calculations will help you see if your answer makes sense.)

1. Names of students in group:

   Choose a mascot migratory shorebird for your group name:______________________

2. a. The average middle school student's weight is 100 lbs or 45 kg. How many grams are there in 45 kg?

   b. Compare the above weight to the weight of the Western Sandpiper which weighs about 25 grams (less than 1 oz). Find an object in the classroom that you think weighs 25 grams. Do this by hypothesizing, not by actually weighing it. What object did you select? Now weigh the objects and record what object came closest.

   c. How many Western Sandpipers (at 25 grams) would it take to equal the weight of an average middle school student (at 45 kg)?

3. a. What's the largest number of quarter-pound hamburgers any student has ever eaten in a single meal?

   b. What percentage of the average weight of a middle school student is this? (Assume that a quarter-pound hamburger = 114 grams.)

c. Compare this with the Golden Plover, which gains enough fat to increase its body weight by almost 30% for its migration from Hawaii to Alaska. If an average student weighing 45 kg were going to increase his/her body weight by 30%, how much weight would s/he gain?

d. How many quarter-pound hamburgers does this equal?

4. a. How long did it take the fastest student to sprint 50 meters?

b. Calculate how long it would take this runner to cover 1 kilometer.

c. Using a map of the world, estimate the distance in kilometers from your school to Lima, Peru. Using your answer from "b" above, calculate how long it would take the fastest student to sprint directly to Lima. (Assume s/he could run in a straight line without stopping.)

Compare these results with Sanderlings, which are able to migrate 7,500 km (4,650 miles) between Oregon and Peru in 230 hours, or about 10 days.

5. a. How many arm flaps can your group's representative do in 10 seconds?

b. Using the time calculated in "4c" above, calculate how many arm flaps a student would make in a "flight" to Lima, Peru.

6. a. Which group member can continue flapping his/her arms the longest? How long?

b. How far do you think the best runner of middle school age can run without stopping? How far do you think the average middle school student can run without stopping?

How does this compare with some plovers, curlews, and tattlers which fly non-stop from Hawaii and other Pacific Islands to Alaska, a distance of over 3,500 miles? The little Western Sandpiper flies over 250 miles per day between stop-over points along the Pacific coast flyway to Alaska.

7. Which group member has lived the farthest away from his/her current home? How many kilometers away is that?

How does this compare with Sanderlings that fly over 11,000 km twice a year from their high-Arctic breeding grounds to nonbreeding ("wintering") grounds in Peru?

8. a. Humans burn about 60 calories by running one kilometer. At this rate, how many calories would you need to run from here to Peru?

b. If one gram of fat yields 9 calories, how many kilograms of fat would you need to eat before making the trip?

c. How does this compare with the Golden Plover, which can travel 3,900 kilometers (2,400 miles) in 48 continuous hours of flying using less than 60 grams (2.1 oz) of body fat?

ADDITIONAL ACTIVITIES: *ADAPTATIONS*

1. **Plumage Coloration I. K-12.** When students are viewing shorebirds on a field trip or in pictures, have them write a list of all the colors they see in the birds' plumage. You might also have them draw the patterns they see in the birds' plumage (in flight or walking). Discuss what colors (of the rainbow) are missing. Are the colors solid or in mottled or banded patterns? Do the colors or patterns blend in to the environment or make the birds stand out? What in the habitat do the colors or patterns match?

2. **Plumage Coloration II. 6-12.** Note that shorebirds regularly ***molt*** (naturally replace) their feathers. Research what plumages they have during one year. What plumage do they have when you see them? Do they maintain the plumage you see locally in some other habitat as well, either before or after they appear in your area? What can you find out about other habitats the birds are found in, and can you determine if their local plumage might actually be better adapted as camouflage for a different habitat than the one you see them in?

3. **Comparing Wings. 2-9.** Have students look at and draw pictures of shorebird wings and compare them with pictures of other birds (e.g., ducks, hawks, hummingbirds, ostriches, penguins) wings. Ask them to consider the differences in the lifestyle (including migration strategy or lack of) when discussing similarities and differences in wing shape. Alternatively, compare shorebird wings with the wings of certain insects. Are there any migratory insects? (Yes, e.g., Monarch Butterfly.)

4. **Flying Abilities. 10-12.** Have students research to learn why birds flying in a flock don't run into each other when they change directions.

5. **Cladograms** (Evolutionary trees). **9-12.** Use an interlibrary loan service to find a copy of a shorebird family evolutionary tree (showing how plovers, sandpipers, and other families have presumably branched apart). Such relationships are also known as the *phylogeny* of a group of organisms. Give it to students along with the names of three bird species. Ask them to figure out where on the tree (which branch) those three birds fit in.

Alternatively, have students research and draw an evolutionary tree of shorebird families. An easier topic would be bird *families* or groups (including shorebirds as well as such groups as raptors, perching birds, and seabirds) in general, or even a tree showing the relationships between all of the Animal *phyla* or vertebrate *classes*.

6. **Shorebird Types. 5-12.** Have students research to discover the main shorebird types (plovers, sandpipers, etc.) and their identifying characteristics. Match a list of species with these groups. Discuss *genera* and *species*. Are birds in the same genus more similar than each other and distinct from birds in different genera?

7. **Scientific Names. 4-10.** Have students practice learning the hierarchical structure (i.e., Kingdom, Phyla, Class, Order, Family, Genus, species) of the animal kingdom and scientific (Latin) names by tracing one or two species of shorebirds through the hierarchy.

8. **Mechanics of Flight. 5-12.** Have students research the mechanics of flight, or compare flight in birds to flight of bats, insects, or airplanes. There are many books and other resources available on this topic, and it makes a fun physics lesson or unit. Discuss fixed versus mobile wings.

9. **Energy Forms and the Role of Oxygen in Energy Transfer and Use. 7-12.** Remember that energy is useful to us only while it is being transferred from one form to another. Use bird flight as an example when studying energy forms. Have students review potential and kinetic energy, and then research or discuss the following: What kind of energy transfer is involved in flight? (Chemical energy is transferred into mechanical energy.) How do birds transfer chemical energy (of food) into mechanical energy (of flight movement)? (Respiration, which requires oxygen.) What role does oxygen play in the trapping of the sun's energy (photosynthesis) and the release of energy (respiration) in animals? What role do hollow bones, bone marrow, and air sacs play in respiration?

KEYWORDS: *ADAPTATIONS*

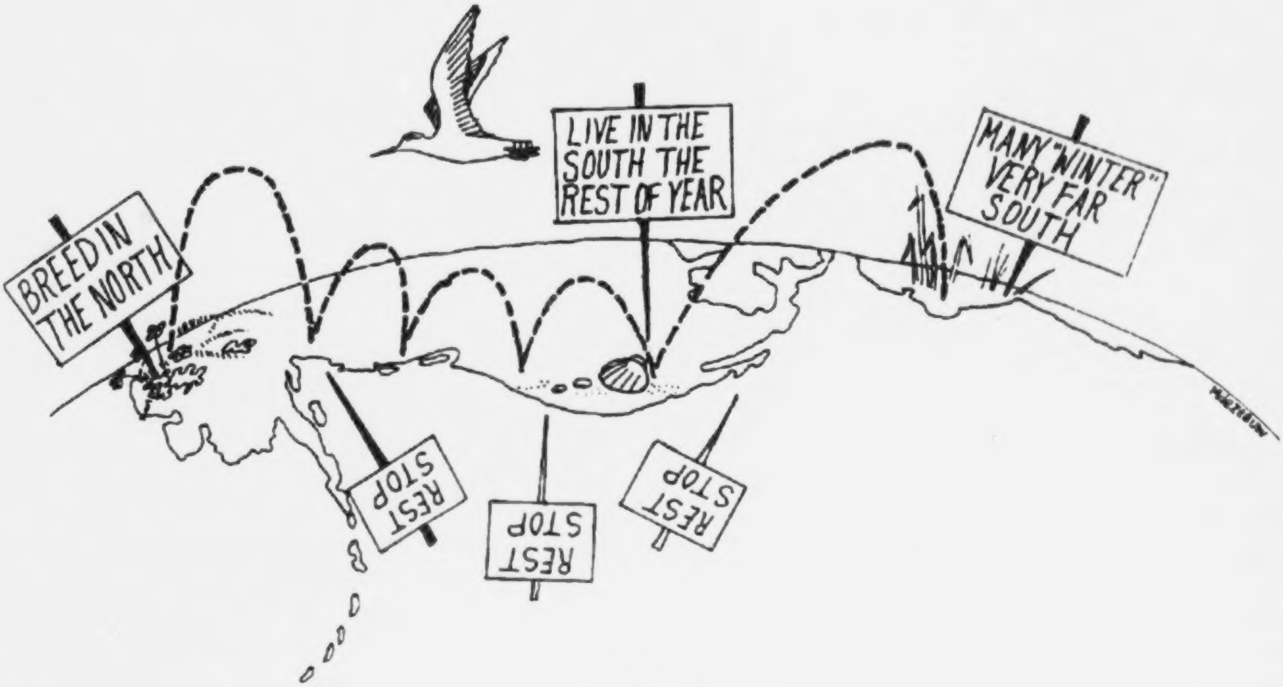
adaptation
advantage
beak
bill
breed
camouflage
competition
diversity
efficiency
environment
feeding success
genes
habitat
molt
natural selection
organism
physiology
species
trait

HABITAT

CONCEPTS:

- *Habitat* is a place where an organism lives because it is adapted to find food, water, and shelter there. During a shorebird's breeding season, its habitat is where it courts, nests, and raises its young.
- Shorebirds depend on at least three different places for habitat every year of their life.
- Wetlands are extremely important shorebird habitat.
- Learn from and learn about your local environment.
- The most serious threat to shorebirds today is loss of habitat.

SHOREBIRDS DEPEND ON THREE HABITATS


BREED IN THE NORTH
LIVE IN THE SOUTH THE REST OF YEAR
MANY "WINTER" VERY FAR SOUTH
REST STOP
REST STOP
REST STOP

HABITAT

A ***habitat*** is the place where an organism obtains energy (food) and water, and finds shelter. Without suitable habitat, the organism would die. Plants, animals, and all other organisms are adapted to live in a particular type of habitat. Terrestrial habitats may be hot or cold, dry or wet, with sandy soils or peat, and include endless other characteristics. Aquatic habitats may be salt- or freshwater, shallow or deep, warm or cold, just to begin describing them. Plants generally only live in one habitat in their lifetime, but animals that can move large distances might use several.

MIGRATION

Migration occurs when an animal moves from one place to another, often from one habitat to another. Usually migration refers to a somewhat *predictable* pattern of such movement. Some planktonic organisms migrate up and down in the water in response to the amount of daylight. In turn, some fish migrate up and down in response to the migration pattern of these plankton upon which they feed. Animals may migrate because of changes in season, food availability, or number or success of competitors. How are these different reasons related to each other? Can you think of any other reasons for migration between habitats?

SIGNIFICANCE FOR SHOREBIRDS OF MIGRATION BETWEEN HABITATS

Birds are capable of the most advanced method of movement on Earth: they can fly. Because of this ability, many of them have evolved to use more than one habitat. Arctic-nesting shorebirds undertake some of the longest migrations in the world. Many of them fly incredible distances each spring to nest on the arctic tundra, and then fly far south again in the fall to spend their "***nonbreeding season***" in a very different habitat. They do this in response to food availability, presence of fewer competitors in the Arctic, and weather change, all of which are very closely associated.

SHOREBIRD HABITATS

In its most basic definition, the habitat of a shorebird is open space. ***Open***, in landscape terms, means "without significant ***canopy*** cover (plants blocking the sky above)." A few shorebird species live or roost in trees or wooded areas, but in general they are adapted to live on sandy or rocky shores, and open grassy areas. For adult shorebirds, shelter is provided more by flocks than by habitat. Individuals in a flock of roosting shorebirds take shelter from the wind behind each other. The bird at the end of the flock that faces the wind will eventually hop to the back of the flock, forcing another to take its turn as windbreak before it, too, hops to the leeward side. Watch for this when you observe a roosting flock on a windy beach!

Migratory shorebirds spend about two months each year nesting and raising their young in inland tundra, muskeg, or grasslands, or on ocean, lake, or river beaches. (See Appendix E for information on the breeding habitats of shorebird species.) They live for most of the rest of the year in generally more southern and coastal areas. In fact, because the ***nonbreeding season*** is so long, shorebirds are more physically adapted to those southern habitats where they spend most of their lives.

There is at least one more habitat, and often several more, that Arctic-nesting shorebirds depend on each year. Besides their breeding and nonbreeding habitats, shorebirds depend on the habitats where they stop to rest and feed during their migratory journey. These stop-over sites tend to be beaches and ***estuaries*** (the wetland area where a stream or river drains into the sea) that are relatively small in size. They are full of abundant food and may support a concentration of thousands or even millions of shorebirds every spring or fall. Many shorebirds have migratory paths which differ in the fall and spring, and therefore use different stop-over sites.

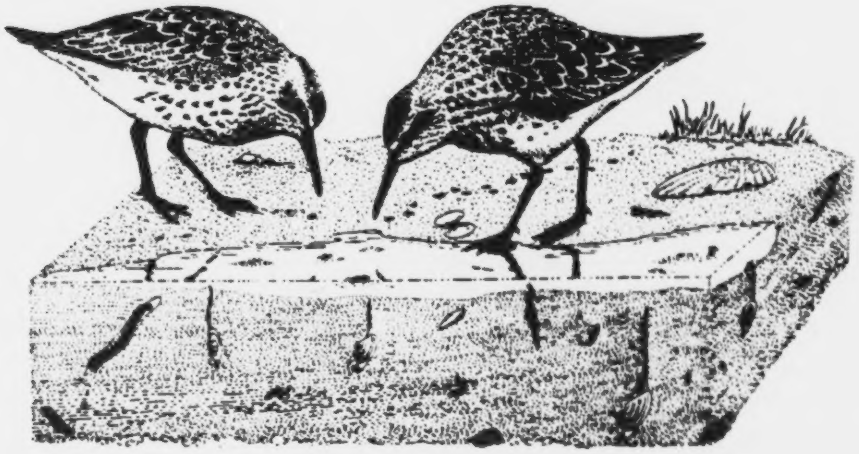
These migratory paths and stops have been used year after year for a very long time. When a large portion of a population of birds are all present at one time on one site, storms or oil spills could kill or injure many individuals and have a significant, negative effect on population size.

Many migrating shorebirds are not flexible enough, nor have the time, to find alternatives to the ***preferred habitat*** of their traditional stopover or nesting sites.

SIGNIFICANCE OF WETLAND HABITAT FOR SHOREBIRDS

Although a given shorebird species may nest on the grassy tundra, stop on migration at ocean beaches and estuaries, and spend its winter on distant mudflats or beaches, all of these different habitats have something in common; most of the habitats that shorebirds depend on are ***wetlands***. As we shall see, there are many types of wetlands. Because they have shallow water (allowing plant growth, penetration of light and warmth, and buoyancy and nourishment for developing young), most wetlands are important sources of food and shelter for many organisms. In other words, they provide essential habitat.

Many shorebirds, like Western Sandpipers, nest on upland tundra in the Arctic. This relatively dry type of tundra is still formed on permafrost, which does not allow precipitation or melting snow to drain, and pools of water abound. Migration and wintering habitats tend to be wetter than where shorebirds nest, although some ***forage*** (look for food) in very wet areas even during the summer.



SHOREBIRDS AND HUMANS SHARE AN IMPORTANT HABITAT

Wetlands are also attractive habitats for humans. Humans use wetlands as a source of water for power, crop irrigation, transportation, drinking, and recreation. We find these areas attractive for housing, and desirable as ports. Highway bridges span them, and water and sewer plants are built near them. ***Runoff*** water from streets and polluted ditches, and sometimes even sewage, empties into them. Great cities like San Francisco, Seattle, and Anchorage have grown up in what were formerly vast wetlands. Non-native ("exotic") species are being introduced into wetlands from such sources as the ballast water of ships: sometimes these ***introduced species*** can outcompete native ones and seriously alter the structure of the wetland.

Unfortunately, the amount of wetland habitat on our planet is limited. Also, most of our use of these fragile wetlands has been permanently destructive. Because wetlands receive runoff water from the surrounding landscape, they receive agricultural chemicals that run off in this water as well. Does water containing the oil from cars and the soap from car washings on your street make its way to a storm drain that empties into local wetlands? Wetlands are being drained and polluted. Our port cities and coastal wetlands face the dangers of accidental oil spills.

As wetland habitat shrinks, shorebirds and countless other animals and plants lose the habitats they rely on. We humans lose wetland habitats important to us for reasons as diverse as clean water, fish, flood control, and tranquil beauty. Is it possible that humans and shorebirds can survive, even thrive, together using the same wetlands? One thing is certain, the more we ***learn*** about the components that make up the habitats of our earth, and the intricate interactions between all the organisms living here, the better our chances of making the best decisions for the future!

WHAT IS A WETLAND?

Bog, mudflat, quagmire, muskeg, tundra, swamp, fen, marsh, pothole, beach – these are some of the many areas that people recognize as definitely land, but also definitely wet. What do we need to know about a wetland to understand why it is important and how it functions?

Let's start by looking at some common features of any wetland. They are measured and studied by people with different jobs.

HOW WET IS IT?

A hydrologist, someone who studies the water cycle, is concerned with the wetness of a specific area. Wetness varies according to how much water falls on it in the form of rain or snow, flows across it from the ocean or upstream, or enters it as ***runoff*** from surrounding higher lands. How long an area stays wet and how wet it stays depend on the type of soil or plants, and how steeply the land slopes to the next downstream area. Water disappears down into cracks and holes between rocks or soil particles, is taken up by thirsty plants, or quickly streams off steep cliff faces. However, some water remains on the surface in areas where a subsurface layer of rock or permafrost won't let it continue down into the ground, or where it enters an existing pond or stream. Wetlands are areas where water remains pooled on or near the surface and saturates the soils, leaving no airspace for oxygen between the grains.

WHAT ADAPTATIONS DOES IT TAKE TO LIVE THERE?

To a biologist, wetlands are places where the plants and animals must have adaptations for both ***terrestrial*** (on land) and ***aquatic*** (in water) life. If the amount of wetness changes, the organism must be able to quickly respond. What would you do to survive if the tide came over your head twice a day? Also, the saturated soil has limited or no oxygen. This means that plants with their roots in the soil and other organisms which live in the soil must have adaptations to these ***anaerobic*** or low-oxygen conditions. The plants and tiny animals with these special traits are part of the wetland food web that includes shorebirds.

HOW DO LAWS DEFINE "WETLANDS"?

Because humans use wetlands for many things, and because humans recognize the importance of wetlands to the overall cycles of nature, there are many laws concerning wetlands. Is the land that you want to build a gravel road across a wetland? Is the land where you saw two rare snowy plovers feeding a wetland? Legal definitions are ones which people use to help answer these questions. These definitions come before the *really* important questions, like how will people and shorebirds be affected by any changes you make to the area?

There are ***regulatory agencies*** which are charged by the Clean Water Act to protect the important functions (like providing drinking water) of wetlands. The regulators have a specific legal definition that recognizes hydrological and ecological conditions described above. However, because the water cycle is dynamic and the wetness of an area varies accordingly, determining whether the legal definition is met in a specific area is often very difficult.

- Activity -

FIVE TYPES OF WETLANDS *FREQUENTLY USED BY SHOREBIRDS*

Background: There are many kinds of wetlands, and each type provides habitat for at least one species of shorebird. Learning about local wetlands means learning about some of the richest and most important habitats in your environment. Comparing and contrasting them with distant wetlands helps us learn about components common to all wetlands. We also need to understand the similarities and differences between habitats to understand some of the reasons why shorebirds can use more than one and why they migrate between them.

On the following pages are descriptions of five types of wetlands that are frequently used by shorebirds: stream/river corridors, tundra, marshes, sandy beaches and mudflats, and the rocky intertidal zone. Below is one activity suggested for use with the readings on wetland types, followed by a list of further lesson ideas.

Grade level: 3 - 12

Objectives: By building a 3-dimensional model, learn principles of geography,and about both the aquatic and terrestrial components of wetlands. Learn that wetlands are a complex of interacting animal and plant life and abiotic elements. Develop the skill of observing in 3-D. Practice the artistic skill of sculptural expression.

Duration: One class period (time depending on grade level) for reading, jigsawing, or other introduction to wetland types.
Plus two 40 to 60-minute class periods (for paper maché-building and painting).

Optional: short field trip to collect twigs, pebbles, mosses, etc..

Materials:
Copies of the readings and drawings of five types of wetlands (included)
Plywood, wood scraps, or small boxes for base of model
Old newspapers
Wallpaper paste or white flour
Bowls and spoons for mixing
Masking tape
Scissors
Glue
Tempera paints
Paint brushes
Decoupage or other clear varnish
Assorted pipe cleaners, tissue paper, toothpicks, small recycled toys

Optional: Collections of twigs, pebbles, grasses, mosses, and bags for collection

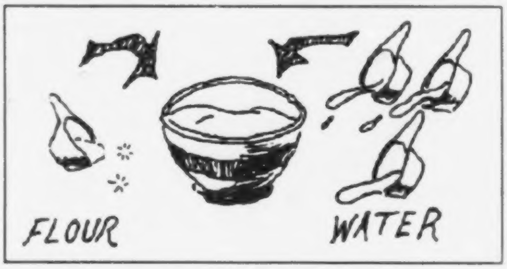
Procedure:

1. Have students "jigsaw" (i.e., each member of a group studies one reading and reports to the other members: see "Additional Activities", below) or read all the wetland readings. Younger students may have the material introduced by you. Then each student picks a wetland type.

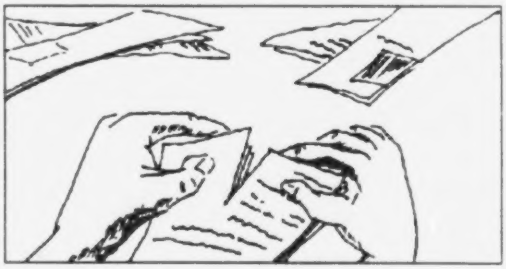
2. Have students underline in the reading all of the *components* of their wetland type. Components can also be listed under "biotic (living)" and "abiotic (nonliving)" headings on a separate piece of paper.

3. ***Optional:*** Take students outdoors to collect small amounts of twigs, pebbles, leaves, grass, moss, even dead insect or snail shells. Stress that *small* amounts only are needed, and that for this activity it is preferable to collect only organisms that are already dead. You may wish to take scissors and small bags for collection. Even in the winter, twigs, pebbles, and moss scraped off the underside of steps may be available. See the section on Field Trips for further information and ideas.

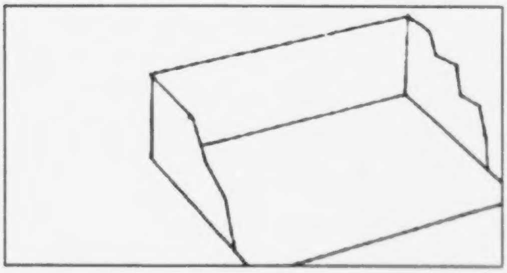
4. Have students create paper maché models of their chosen wetland types. Tell students that a model should contain or display at least three biotic (e.g. Red-necked Phalarope, snails, grasses) and three abiotic (e.g. snow, gravel, water) components from the list generated above. After completing the painting, they can attach paper cutouts or bits of the natural material they collected to simulate wetland components:



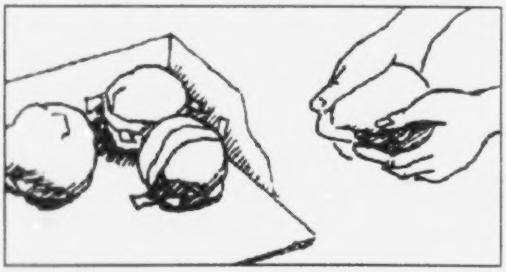
a). Mix wallpaper paste or flour with water until it is like thin cream without any lumps.



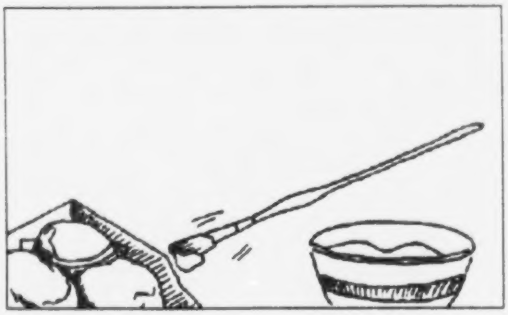
b). Tear sheets of newspapers into long strips, about 1 inch wide and 6 inches long.



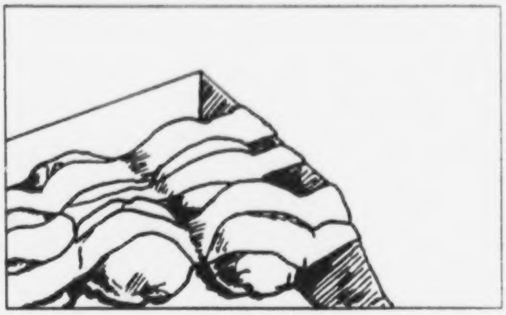
c). If necessary, cut box into desired shape. This will form the base on which to build.



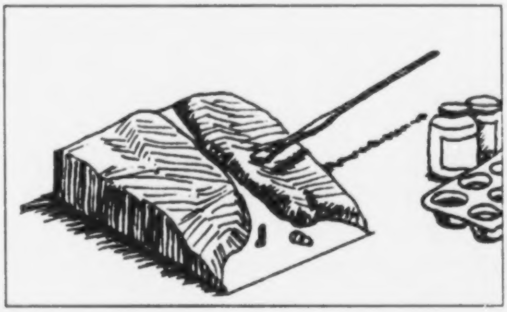
d). Scrunch up newspaper into tight balls and tape into place as hills or tussocks.



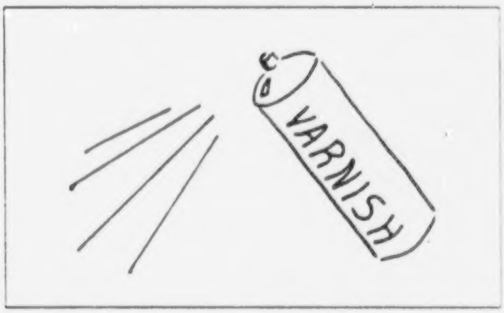
e). Brush paste mixture over newspaper.



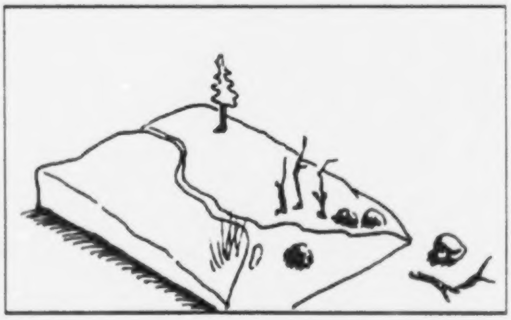
f). Smooth and shape the form by layering strips of newspaper over it, brushing paste between layers.



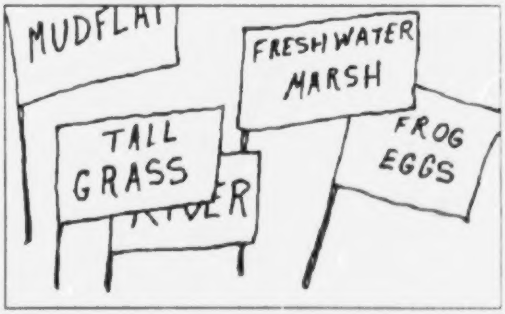
g). Let the form dry for at least one day. Then paint the wetland model all over with a thick layer of paint.



h). To help seal and prolong the life of the model, brush with decoupage or spray with varnish.



i). Attach paper plants and animals, or the ones you collected, to complete a stream/river corridor, tundra, marsh, beach, or mudflat.


MUDFLAT
FRESH WATER MARSH
TALL GRASS
RIVER
FROG EGGS

j). Make labels for the wetland components out of paper and toothpicks.

Extensions:

1. **Pre-test. 5-12.** Have students do a "fast-write," instructing them to take out a sheet of paper and write down everything they know about wetlands in three minutes.

2. **"Jig-saw" the Reading. 5-12.** Practice cooperative group and presentation skills by "jigsawing" the readings, with four cooperative groups each studying and presenting a different wetland type to the class. Assign tasks: drawing plants, animals, and abiotic parts of the wetland; preparing and coordinating the oral presentation; doing additional research in one other source; etc.

3. **Underline Key Concepts. 3-9.** Practice careful reading skills by having students underline in the reading all of the components of each wetland type. Components can also be listed under "biotic (living)" or "abiotic (nonliving)" headings.

4. **Make Direct Comparisons. 5-9.** Have students practice critical thinking skills by drawing comparisons and contrasts between the wetland types, either by constructing a table, making lists, or forming complete sentences. Sample questions:
   - Describe three traits that all these wetlands have in common.
   - List two things unique to each wetland.
   - Which of these wetlands are salty?
   - Which of these wetland types occur closest to your school? In one sentence (bonus for extra reasons) explain why the wetland near your school is [that type] and not [some other type of wetland]. *Sample answer:* The wetland nearest Galena City School is a freshwater marsh and not a mudflat because there is a lot of grassy vegetation there.

5. **Draw and Label. 2-12.**

   A. Have students practice careful reading and drawing skills by drawing their own pictures of a wetland type.

   B. If students have already gone on a wetland field trip and learned a lot about wetland food (energy) webs, they can label their drawing. They can also draw arrows showing connections between components. Give one point for each correct plant, animal, abiotic factor and believable connection (make sure and ask them to verbally explain if you question some of their components or connections).

6. **Large Class Model. 1-9.** Instead of individual papier maché models, have the class work on one large model which incorporates the five wetland types into the landscape. Assign individual tasks (e.g., collection and care of materials, landscape planning) or sections.

7. **Picture Search. 4-8.** Practice critical thinking, observation, and library skills by finding pictorial examples of two very different wetlands for *one* type, and describing to the teacher or class at least one important way they differ. For example, a student finds a picture of a coastal marsh and another of a freshwater marsh, and explains that one is saltwater, and the other fresh. One student may compare a picture of tundra in the winter with one in summer. Another may compare a marsh in a tropical locale with another at high latitude. Students may notice that different types of flowers, heights of plants, or different animals are present.

   Notes: A short, oral activity like this works well as an extra-credit assignment or time-filler while in the library. For younger students, select a variety of story books, encyclopedias, text books, etc. first and set them out on a table.

8. **Imagine and Describe. 5-8.** Instruct students to find a picture of tundra in a book or magazine. Ask them to describe in words, orally or in a one paragraph essay, what a nest in this place would be like. (Wet? Buggy? Noisy? Quiet? Breezy? Still? Light or dark until what time? Made of what materials?)

9. **Other Wetland Types. 8-12.** Have students research other wetland types. They can brainstorm what these may be, or you can suggest bog, muskeg, and swamp. Instruct them to compare, perhaps in table form, use by Arctic-nesting shorebirds and a description of the habitats.

10. **Concept/Bubble Map. 10-12.** Students can practice critical thinking skills by drawing a concept map around the theme of "shorebirds" and including specific components in the readings along with the following terms: wetlands, stream/river corridors, tundra, marshes, coastal/intertidal areas. For specific directions, see the "Bubble Map" activity (page 117) in the "Nesting and Breeding" chapter.

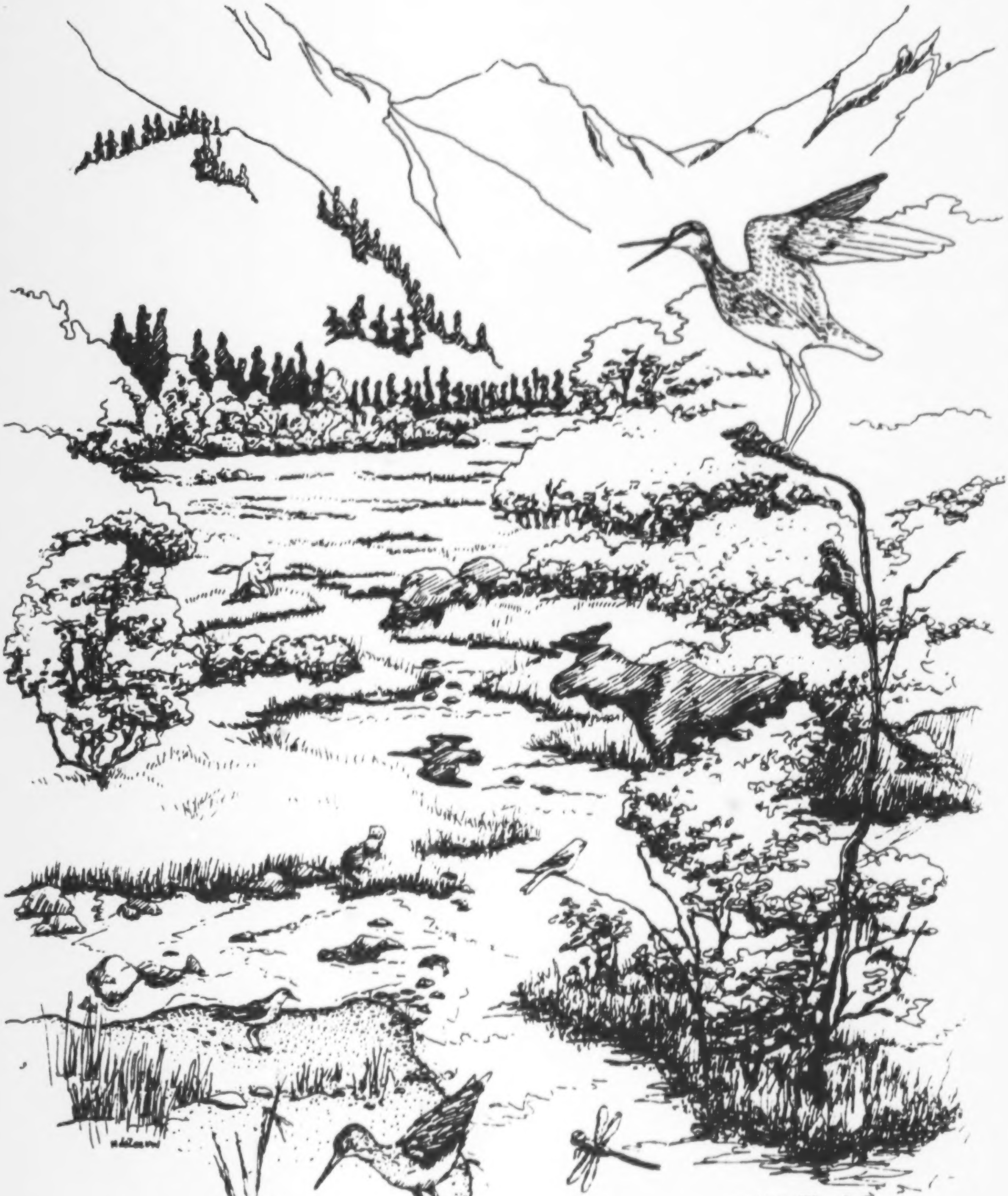
WETLAND TYPE 1: STREAM & RIVER CORRIDORS

In many parts of the world, wetlands undergo a natural change with the seasons. In the spring, snow and ice melt in the mountains. The meltwater causes streams and rivers to rise and seasonal floods to rush downstream. The streams and rivers overflow all along their routes to the ***estuaries*** (where fresh and salt water meet) at the sea and fill lowlands.

The meltwater carries ***nutrients*** (natural chemicals from water or minerals needed by plants for making food). These fertilize plants growing in the flooded lowlands. The plants provide food for many different kinds of small animals. Fish, mammals, and birds feed on the smaller animals.

Shorebirds flying north stop and probe in the mud for small animals like snails, worms, and insect larvae. Inland stream and river corridors (also called *riparian* habitat) are good wetland habitat for shorebirds in the spring. Some shorebirds that can be found in these habitats in the spring include Solitary and Spotted Sandpipers and Yellowlegs. These are migratory shorebirds like the Western Sandpiper but, unlike the Western Sandpiper, they breed primarily south of the Arctic.

After the spring meltwater has all run downstream, the rivers and streams fall to very low water levels. This tends to be true in late summer (July to September, depending on where you live). The plants and animals which live along the river corridors must be adapted to survive a couple of months of dry conditions. Fall rains will then come. They will cause the rivers and streams to rise and flood the lowlands again before winter. Is there a river near where you live? Look carefully for shorebirds and other birds using the banks of streams and rivers.



Stream and River Corridors

- Student Reading -

WETLAND TYPE 2: TUNDRA

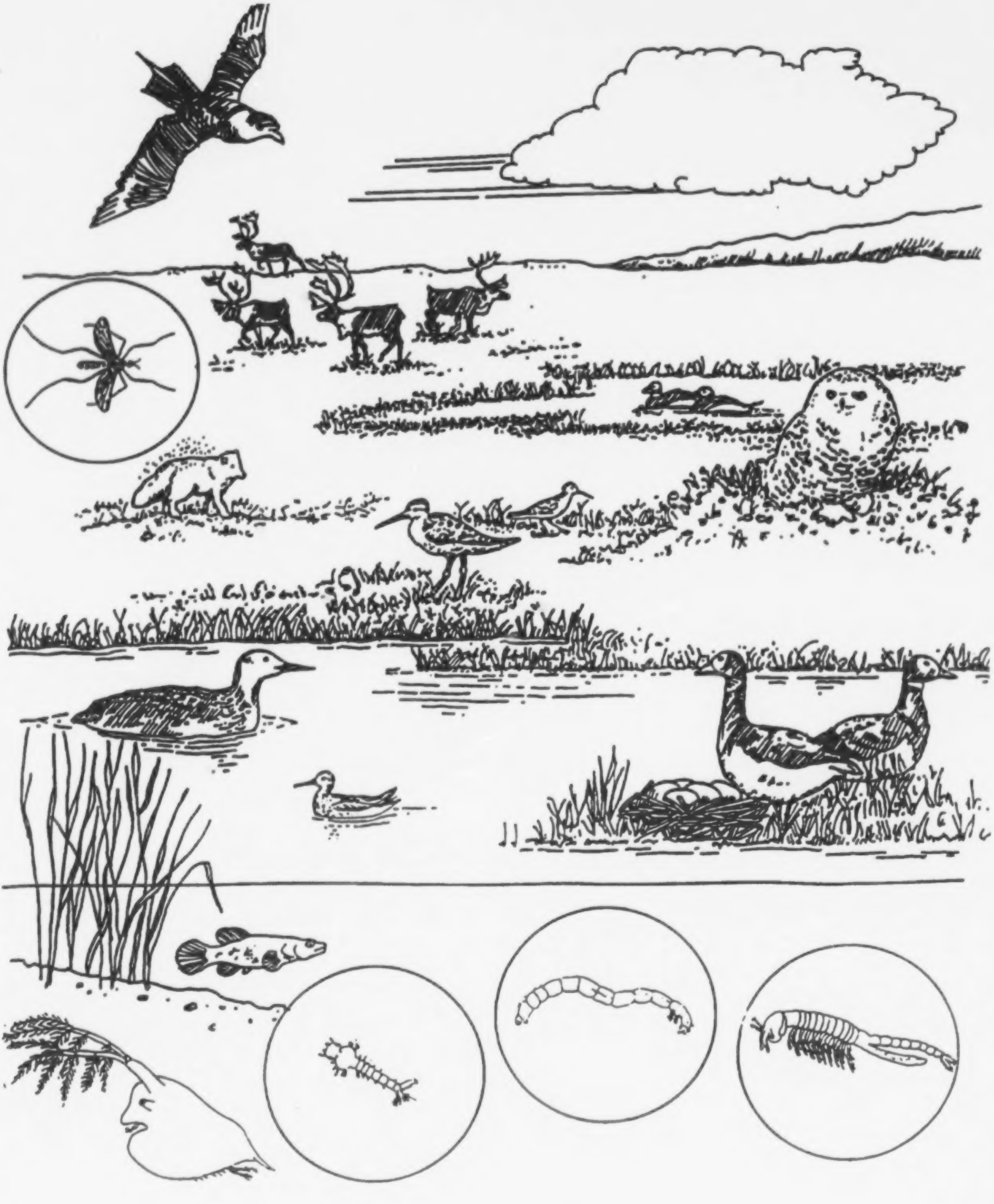
The ***tundra*** is a vast, treeless land of northern and western Alaska and northern Canada. The temperature is very cold in winter and cool in summer. The wind almost always blows. Because of the cold and wind, no trees grow on the tundra. All the plants grow very close to the ground because it is warmer there.

Many people think the tundra is flat. Once you've walked on the tundra, you soon know that it is made up of lots of little mounds of grass, sedges, and lichens. The low spots are wet or even filled with water, forming little ponds or lakes. The ground is squishy. Even where it looks high and dry, it often isn't. Try sitting on a grassy mound for a few minutes!

Although the tundra feels wet, very little rain or snow fall on the tundra each year. Why is it wet? This is because there is permanently frozen ground, called ***permafrost***, under the thin layer of topsoil. Because of permafrost under the soil, most of the rain and snow which falls stays on or near the surface. It can't drain away through the frozen soil. Permafrost doesn't thaw, even in summer. You cannot dig more than a few inches into the frozen soil. However, centuries of decaying vegetation have produced a thick, spongy layer called ***peat***.

Because of permafrost, plants on the tundra have roots that grow sideways (*prostrate*) instead of straight down. One example is dwarf willow. There are also many berry-producing plants like cloudberry and bearberry on the tundra. Fungi and lichens (Are these plants? What are they?) are very important tundra organisms too.

Millions of shorebirds nest each year on the tundra. They feed on the billions of larvae and hatching insects that appear each summer. They also find aquatic prey like copepods and fairy shrimp.



Tundra

Source of illustration: *Wetlands & Wildlife.*

74

- Student Reading -

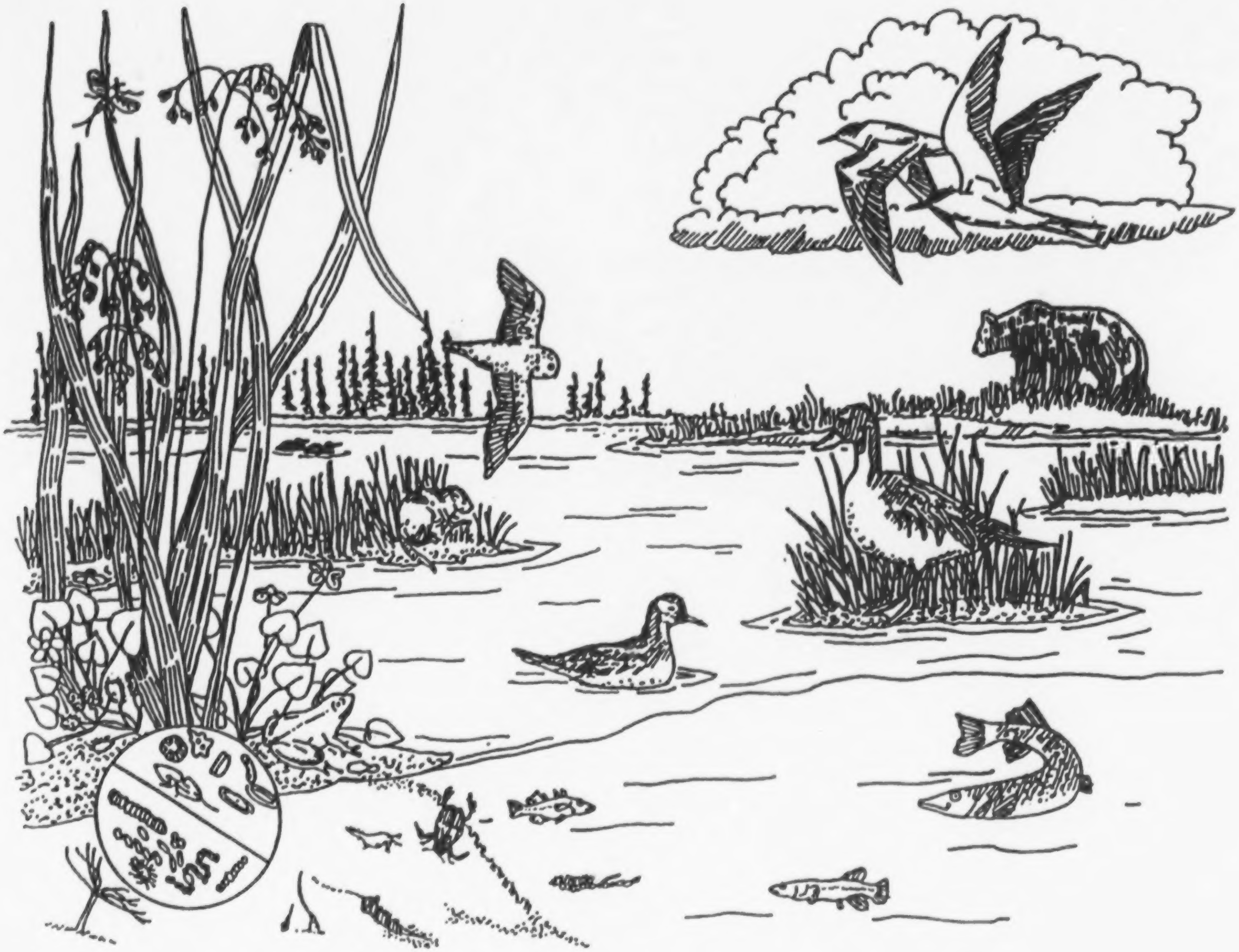
WETLAND TYPE 3: MARSHES

Marshes can fill broad, flat areas or be contained in tiny pockets surrounded by higher land. They are often found on the edges of ponds, lakes, or rivers. Often a saltwater marsh is associated with an ***estuary***, the place where freshwater of a river mixes with the saltwater of the ocean. If there is a stream or other water movement through a marsh, nutrients are brought with the water flow. When water drains from a marsh, it carries nutrients to the next wetland or to the ocean.

Marshes are open, wet, grassy areas. There are two kinds of marshes: inland ***freshwater marshes*** and coastal ***saltwater marshes***. The inland marshes obtain freshwater from creeks and streams or directly from rain and snow. Tides regularly bring a source of saltwater to the coastal marshes. Both inland freshwater marshes and coastal saltwater marshes have plants which are adapted to the type of water in the marsh.

On a windy day marsh plants rustle with their own unique music. The plants that grow in a marsh are special. Their roots are always under the water. Their stems and leaves rise out of the water into the air and sunlight. Marsh plants grow where water is shallow and slow-moving. Some marsh plants of western North America include sedges, rushes, and grasses. That's why a marsh looks like a wet meadow. Marshes also have small shrubs and delicate flowering herbs.

Insects, snails, and other small animals thrive among the plants in the slow-moving water. Fish and aquatic insects find shelter among the underwater parts of the plants. Young salmon start their lives in freshwater far upstream. Before they graduate to the ocean, they need time to adapt to saltwater. Coastal saltwater marshes are the perfect place to do that. Shorebirds and other birds can find lots of food to eat in a marsh. They can hide in the tall grass from predators. Have you ever seen a Common Snipe, a yellowlegs, a dowitcher, or a phalarope in a marsh?



Marshes

Source of illustration: Wetlands & Wildlife.

- Student Reading -

WETLAND TYPE 4: ROCKY INTERTIDAL

The ***intertidal zone*** is the part of the ocean shoreline that is covered by saltwater when the tide is high, and exposed to the air when the tide is low.

Life in intertidal areas has both challenges and rewards. Plants, animals, and other organisms like ***algae*** ("seaweed") must be very tough to live there. They must be able to adapt to the movement of the tides. This means being able to live covered and then uncovered by water once or twice a day:

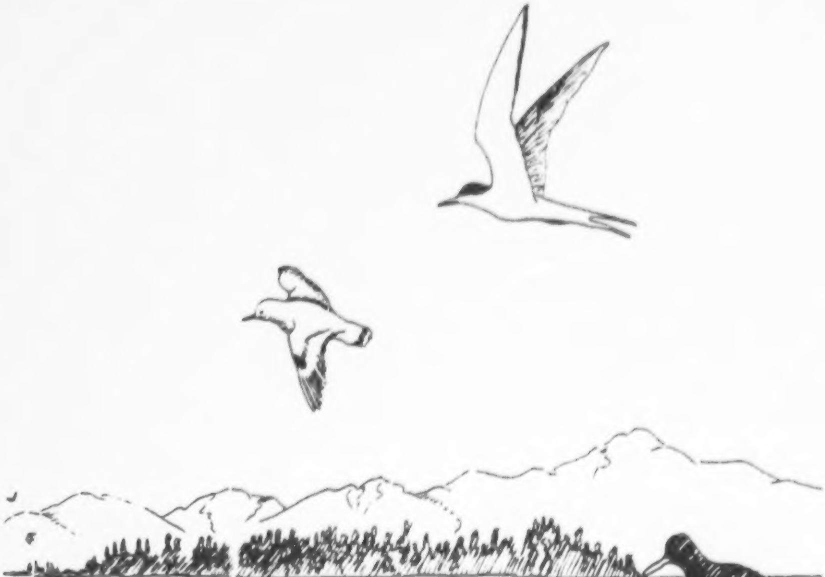
- They must be able to get oxygen in air and in water.
- If living cells dry out, they die. Living creatures of the intertidal must be adapted to keep from drying out when the tide is low.
- They must be able to adjust to changes in ***salinity*** (level of saltiness). As the last drops of water dry in the sun at low tide, salt is often left behind and conditions can be even saltier than when underwater (how could you test to see if that is true?). When it rains, these same plants and animals must be able to adjust now to lower salinity.

Saltmarshes, sandy beaches, rocky beaches, and mudflats can all occur in the intertidal zone. Because the rocky intertidal zone has no soil to retain water, some might argue that it is not really a "wetland" habitat. Well, the ***rocky intertidal*** is that part of the zone which is made up of boulders or cliffs or gravel or shale or just plain rocks. Wherever there are pools or crevices to retain enough water, the rocky intertidal teems with life. This is why we also know this zone as the place of ***tidepool habitat***. Like most wetlands, it is a very productive place!

There are other challenges facing the tidepool life and the hardy organisms that cling to exposed rock walls. These include being able to adapt to the rolling or even pounding of the ocean waves. Wave action is often high in these areas, and often the cause of why there is no soil on these exposed rocks.

Almost no terrestrial plants grow in the rocky intertidal habitat; there is no soil for their roots. Instead, seaweeds and kelp (now often considered to be members of the *Protista* Kingdom) take the ***niche*** of plants. This means that they do the job of plants at the base of the food pyramid and in the general ecology of the habitat. They capture the sun's energy to make food that tiny animals graze on, and they provide a sheltered place for these tiny animals to live.

The larger animals (*predators* and *scavengers*) that feed on the smaller animals face their own challenges here. This habitat is exposed to a lot of wind, and there is not much shelter for them. Many shorebird species are well-adapted to find food in the rocky intertidal. As a matter of fact, as birds go, shorebirds are the most significant users of the rocky intertidal. The Black Oystercatcher feeds almost nowhere but here most of the year. Its strong, red bill is adapted specifically for prying hardshelled animals off rocks or prying them open. Turnstones, Surfbirds and Rock Sandpipers also live here during migration and in winter.



Rocky Intertidal

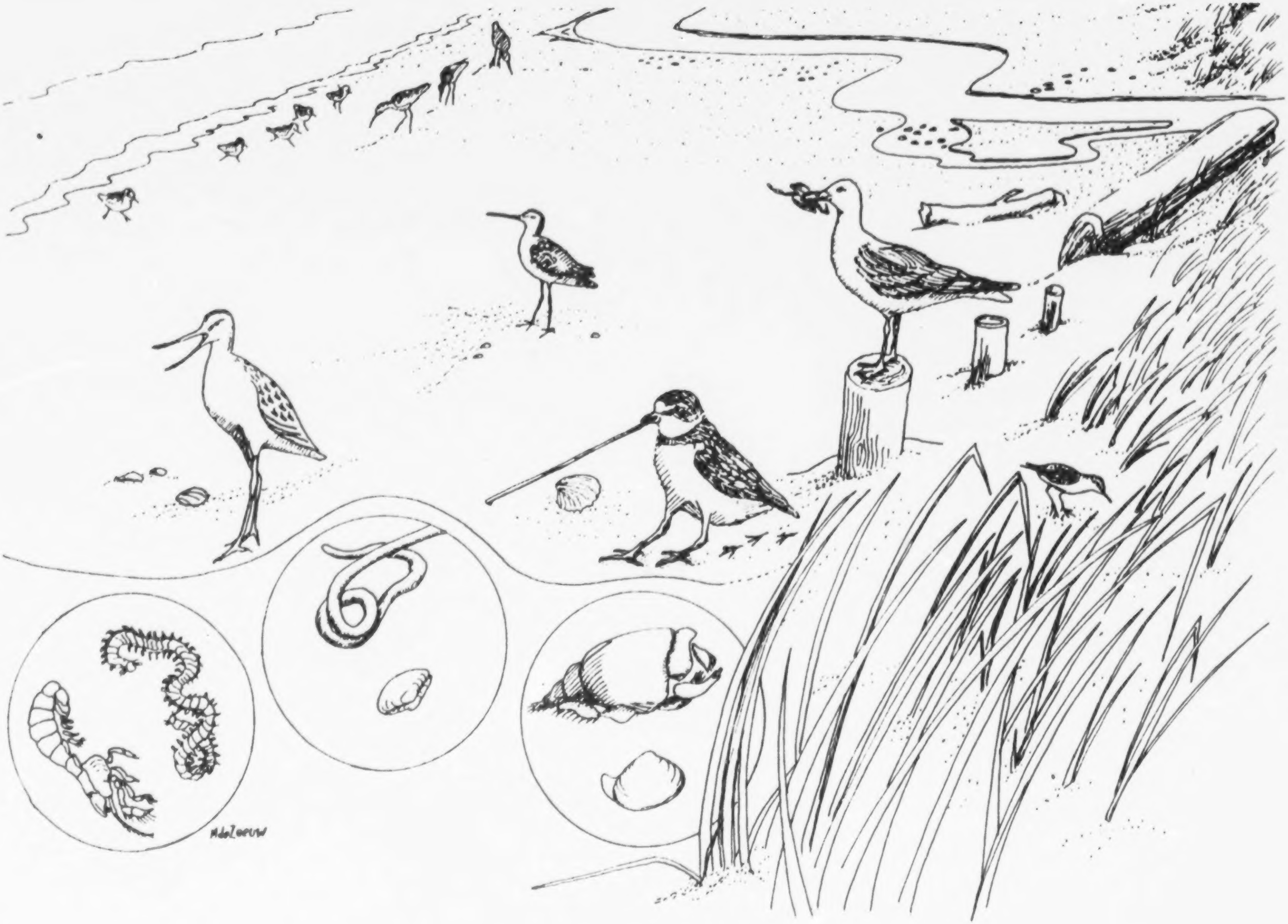
- Student Reading -

WETLAND TYPE 5: MUDFLATS AND SANDY BEACHES

Mudflats and sandy beaches are important shorebird habitat. They can occur inland, but sandy beaches especially are found in the intertidal zone along the ocean shores. Mudflats are made of differently-sized particles than those composing sandy beaches. They can occur around inland lakes and rivers, but can also be intertidal. What do coastal mudflats and sandy beaches have in common besides the tide? They are both very open habitats with few plants but often rich in invertebrate prey.

Organisms that can adapt to conditions of periodic wetness and salinity changes do well because there are lots of nutrients in these mudflat and beach habitats. These elements are carried down by rivers and mix with nutrients from the ocean or lake. Such wetlands, especially in coastal areas, are some of the most ***productive*** (maker of food) areas on the earth. If you scooped up one pail of mud or sand from the beach below the high water mark and examined it with a microscope, you would see hundreds or thousands of tiny snails, worms, and invertebrate eggs and larva. There would be larger animals like clams and long worms as well. There are millions of clams, shrimp, and worms buried in the mud and sand in intertidal mudflat and sandy beach zones.

The flight path for millions of migrating shorebirds follows the shoreline as they move north in spring or south in fall. The birds need a lot of energy-rich food to fly thousands of miles. Their next stop might be hundreds or thousands of miles away.



Mudflats and Sandy Beaches

- Activity -

WETLAND METAPHORS

Background: Coastal and freshwater wetlands provide unique habitats for a great diversity of plants and animals. They are nurseries for countless life forms.

Freshwater wetlands often act as buffers in times of both flood and drought. Absorbing overflow from flooding, wetlands often swell with runoff water and reduce potential flooding downstream. In drier periods, wetlands hold precious moisture after other ponds and lakes have disappeared.

Wetlands have a unique ability to trap silt and other solids, promoting the ***decomposition*** of many toxic substances and the neutralization of sewage wastes by ***microorganisms*** that live there. Yet it must be remembered that as remarkable as they are, the actions and capacities of wetlands have limits. Too much pollution can destroy a wetland.

Many of the functions of wetlands can be explored through ***metaphors***. A metaphor is a direct comparison between two things. It gives a vivid *image* through direct (i.e., without using the terms "like" or "such as") comparison. "A tree is a home," "books are windows of thought," and "she is a tower of strength" are examples of metaphors. In this activity, a variety of objects represent the characteristics of wetlands in order to help students visualize (i.e.,"paint a picture") and remember the valuable functions of wetlands.

Grade level: 2 - 9

Objectives: Create and use metaphors to help understand the basic conditions and process in a wetland. Understand the value of wetlands. Investigate the interrelationships of living things in wetland ecosystems. Practice skills of analysis, application, articulating concepts, visualization, and interpretation. Practice working in small groups and public speaking.

Duration: One 30-minute class period

Materials:

Large, concealing container
  (pillowcase, bag, or box)
Sponge
Small pillow
Egg beater
Doll's cradle or baby doll
Sieve or strainer
Can of soup

Optional and additional for younger students:
pictures that illustrate other
  comparisons (such as gardens/food production for animals, airports/landing and takeoff places for migrating birds)

Teacher Preparation:

Prepare the "Mystery Metaphor Container" by placing the metaphor objects in a concealing box or paper sack.

Procedure:

1. Discuss wetland functions and the meaning of *metaphor* (as in metaphorical objects) with the class. Metaphors offer a dramatic way of drawing a comparison. For example: "Robin is a chip off the old block" or "Wes is a barrel of laughs."

2. Tell students that objects can be used to represent wetland functions.

3. Now bring out the Mystery Metaphor Container. Tell the students that everything in the container can be a metaphor that relates to the functions of wetlands.

4. Divide the class into six different groups. Announce that when it is their turn, you want a representative of each group to draw an object from the container.

5. Have the designated student reach into the container and withdraw one object.

Object	Metaphorical Wetland Function: "Wetlands...
Sponge	... 1) absorb excess water to help prevent flooding, and 2) absorb excess, harmful nutrients from fertilizers and other sources that may cause contamination downstream (related also to filtering, see "Sieve" below)
Pillow or Bed	... provide 1) a resting place for migratory birds, and 2) a home for resident microorganisms, fish, birds, and wildlife
Egg beater	Nutrients and oxygen are mixed in fresh and salt water
Cradle or Baby doll	... shelter and protect like a nursery for young fish, insects, mammals, and birds. Have you seen mosquito larvae, dragonfly nymphs, frog eggs, duck nests, or moose calves in wetlands? Young salmon in the Kenai River need the shelter of slow-moving water and grasses. Arctic-nesting shorebird young are raised in tundra wetlands.
Sieve	... strain or filter debris and suspended material out of the water, cleansing polluted water that enters. (Of course, even Wonderful Wetlands can be overpowered by too much pollution!)
Can of soup	... provide food for many animals, in the form of phytoplankton, algae, tiny zooplankton, insects, and fish

6. When each group has an object, ask them to describe and demonstrate the relationships between their object and wetlands. Encourage the students to build on each others' ideas. You can also assist by strengthening their connections. See the chart on the previous page for guidelines. Be sure to allow the students time to discuss their ideas in their groups before presenting to the class.

7. Ask students to summarize the major roles that wetlands perform in contributing to a healthy habitat for wildlife. Ask them if their own attitudes about wetlands are different as a result of doing this activity. If so, how?

Extensions:

1. **Poetry Writing.** Have each student write a poem or essay about wetlands using a metaphor. This lesson is especially appropriate **after a field trip**.

2. **Translate metaphor to picture.** Have students use drawing or painting materials to create an actual image of a metaphor (i.e., a tree as a home, or a person as a chip off the old block).

3. **Shorebird Metaphors.** After a field trip to observe shorebirds, have students brainstorm other wetland metaphors that demonstrate the value or function of wetlands specifically for shorebirds (e.g., airport; bus transfer ticket for migration; restaurant; "singles" meeting place; even a place or ticket that represents freedom, which shorebirds would lose if they were endangered and confined to zoos).

Advanced Students:

4. **Research Concept of Nutrients.** Notice that some items thought of as ***nutrients***, which are normally good, and indeed vital, can sometimes be detrimental. Have students research to explore the difference and explain why. Make sure they first thoroughly explain what nutrients are.

Adapted originally from "Wetland Metaphors", Aquatic Project WILD.

- Activity -

MATCH THE HABITAT CARDS

Grade level: 5 - 12

Objectives: By playing a card-matching game in which all students will find themselves participating, they learn facts about the diversity of shorebird habitat. Learn that a "habitat" is not just a place, but a place where organisms find food, or a place to breed or rest. Learn that shorebirds are matched with habitats because of their specific needs. Practice careful reading, literature and map resource use, and participation skills.

Duration: One 40-minute class period.

Materials: Set of cards made from blank index cards according to the instructions below

Note: 20 to 40 possible matches (40 to 80 cards) is a good level for eighth grade students and above. For younger students, try 15 (30 cards). You may choose to increase the number slightly for small classes (five to ten students).

Younger students: Alphabetical list of student names, posted in large letters

Teacher Preparation:

1. Make a set of index cards with one different shorebird habitat term on each card.

2. Print definitions for each term on another set of index cards. A sample set of terms and definitions is suggested below. When varying or supplementing definitions, make sure not to use ones copied word for word from student readings or texts.

Procedure:

1. Have students take out a blank sheet or two of notebook paper to write their sentences on (explained below). They should also have their shorebird habitat readings available as resource material.

2. Mix term and definition cards together and shuffle. Deal cards to students. It is not necessary, and indeed improbable, that all students initially receive the same number of cards.

3. Explain the **Student Directions**:
   a) The object of the game is to make as many matches as possible in the given amount of time. 30 minutes is suggested.

   b) Tell students the number that is possible (ex: 60 cards, 30 matches).

   c) Point out that more than one definition may match a term, but they should be looking for the *best* match.

d) They must get out of their seats, find the matching cards, and write down on their papers *exactly* what the cards say. *This is a critical part of the game, because this way the teacher can tell that they actually found the match, and didn't just make up a definition or copy one from a book glossary.*

> ***Note:*** Alternatively, students must form sentences using the pair of cards *and* the word "shorebird(s)."

e) You may choose to have them write the terms and definitions as a complete sentence ("A wetland is land that is covered or saturated with water at least part of the time"). Alternatively, you may choose to have students simply write the term and definition separated by a period or "equals" sign. Write an example of your instruction on the board.

f) Once a student finds the person with a matching card, both people write down the sentence. Do not actually *exchange* cards.

g) The original owner of the term card then passes that card to the classmate whose name comes alphabetically after his or hers. The owner of the matching definition card does the same.

> ***Example:*** Wesley has the card "wetland" and recognizes that Franny's card which says "land that is covered or saturated with water at least part of the time" is the match. Wesley and Franny each write "A wetland is land that is covered or saturated with water at least part of the time" on to their own piece of paper. Then Wesley passes the"wetland" term card to William (or Archie, if Wesley is the last student, alphabetically, in the class), and Franny passes the definition card to Grace (because "Grace" is the first name in the class, alphabetically, after "Franny"). You may have the students determine who they will each be passing all their cards to (i.e. Franny always passes to Grace) before proceeding with the game.

4. The teacher will find it handy to keep a private "clue" sheet of sources. Use the "Source Clue" column of the chart above to record page references from readings available to students. If the teacher notices that a student is really stumped on a card, he or she can be referred to "page so and so in such and such reading" for help with a definition. Knowing a basic definition should help them recognize the actual one given on the matching card, wherever it is.

5. The game ends and students turn in their lists when the time limit has run out.

6. You may want to follow with a discussion to ensure that all students have a chance to familiarize themselves with all of the terms. Alternatively, go around the room and have each student read a sentence and see if the rest of the class agrees that he or she has made the best match. What other matches might work?

Sample Card Terms and Definitions:

Term Cards	Definition Cards	Source Clue
habitat	a place where organisms are adapted to live and find food and shelter	(Record a page # or name of student handout here. When one needs a clue, give him/her this reference number: "Alfred, see the *'3 Habitats'* handout.")
wetland	land that is covered or saturated (soaked) with water at least part of the time	
alpine	habitat found at heights above the treeline	
ocean beach	sandy habitat affected by the tides *alternatively:* home of oystercatchers and migrating Sanderlings	
mudflat	mud habitat that is exposed at low tide and is a home to many invertebrate animals	
freshwater marsh	inland habitat where the roots of grasses, sedges, and rushes are always under water	
saltwater marsh	coastal habitat made of ocean water and plants adapted to salt water	
tundra	northern wetland habitat with permafrost and no trees	
intertidal zone	nutrient-rich, rocky beach habitat between high and low tide mark	
muskeg	northern bog of moss and small spruce trees	
roost	flock of resting shorebirds, or the place where they rest together on migration or in winter	
tide	daily movement of ocean water as it is affected by the moon's gravity	
sphagnum moss	small wet plant which soaks up moisture in muskeg	
permafrost	permanently frozen subsoil of the tundra	
scrape	shallow shorebird nest made of gravel or bits of shells	
migration	regular movement of shorebirds every spring and fall	
stop-over sites	important habitats where shorebirds stop every year on migration	

Term Cards	Definition Cards	Source Clue
shorebird nonbreeding season	winter, if it occurs in the northern hemisphere	
shorebird breeding season	summer, if it occurs in the northern hemisphere	
shelter	where shorebirds are protected from predators or environmental conditions	
food	for Western Sandpipers, includes tiny clams and worms in the winter, and insects in the summer	
macoma clam	shorebird food item found in Pacific beaches	
crustacean	group of animals that includes small shrimp and crabs which shorebirds, especially phalaropes, feed on	
Copper River Delta	migration stop-over site near Cordova, Alaska	
Montague Island	surfbird migration stop-over site in Prince William Sound	
Stikine River Delta	migration stop-over site in Southeast Alaska	
Nelson Lagoon	migration stop-over site on the northern Alaska Peninsula	
Yukon Delta	migration stop-over site west of Bethel	
North Slope	breeding grounds for many shorebirds north of the Brooks Range	
South America	large continent where many arctic-nesting shorebirds spend their nonbreeding season	
Hawaii	state where you might find Pacific Golden Plovers in the winter	
Canada	Nearctic country that contains vast tundra habitat, particularly high, rocky tundra	
Russia	country that extends north into the Palearctic, and east toward Alaska	
Nearctic	North American arctic region	
Palearctic	Northern Europe and Asian arctic region	

Notes for Teacher:

- Let students discover, on their own, efficient ways to find matches (like spreading out their cards on the desk in front of them).
- Some students will accumulate a large pile of cards as the speedy student alphabetically ahead of them keeps passing them on, and others will quickly go through their own cards. Either way, they will find that they need to get up out of their places, move around the room, and *communicate* to search for matches. The teacher needs to move around the room and facilitate the discovery and passing on of cards.
- As the subject comes up, tell students that it's perfectly ok if the holder of one of your matches happens to be the person who comes alphabetically after you. Pass him or her your card anyway, after you've both written down the sentence, and the match-holder will just immediately pass the card on again.
- You may choose to count as correct some matches which work, though they aren't "the best".
- Tell students that they can, and should, use their readings, maps, and books to help them.
- Card masters are not provided here for the following reasons:

  a). Making home-made cards from long-lasting blank index cards gives teachers the flexibility of using a multidisciplinary approach and/or inserting additional, identical-looking cards at any time.

  b). Teachers may choose to vary the definitions according to reading level of students.

  c). Teachers may wish to vary the definitions slightly according to other material studied or source material available for "clues" (see below). They may wish to combine information studied in the migration and/or nesting and breeding sections with these habitat terms.

  d). If all students have access to a source such as the "Factsheet on Some Common Shorebirds" or other shorebird guide, the teacher may choose to alter the definitions so that they reflect the habits of specific shorebirds. See the examples of alternatives below.

Alternative definitions based on species-specific information:

Term Cards	Definition Cards
Surfbird	nests in alpine tundra
pampas	wintering habitat of American Golden-Plover
mudflats	habitat type where migrating Dunlin and Western Sandpipers are found

Assessment Suggestions:

These are simply a few of the ways you may choose to grade participation in this activity, based on the level of the class.

1. One point for each correct sentence.
2. Points for participation.
3. *All* participating students would earn, say, 10 points. Students could get an extra credit point for each correct sentence after, say, 15 sentences.

Extensions:

After students have played this game and are familiar with it, there are a variety of extensions and modifications which can facilitate further learning about shorebird habitat as well as other subjects:

1. Have each student draw a picture that represents one of the matches. The pictures can be hung up or presented to the class, and classmates try to guess what each picture represents.

2. Hand out four index cards to each student (more for smaller classes), and instruct students to choose two of their own shorebird habitat terms and compose definitions for them. Gather all of the cards, shuffle, and play the game with the student-made cards.

3. This game works very well to encourage participation, familiarity with terms, and source use for other subject areas that involve a lot of vocabulary or names, like history, chemistry, and general biology.

- Activity -

DESCRIBE A LOCAL HABITAT

Grade level: 4 - 12

Objectives: Learn about a local habitat. Learn that one type of habitat provides a home for many organisms. Explore the interaction of local people with their environment. Practice field and library research skills. Practice cooperation and oral presentation skills.

Duration: Three class periods, including one field trip, one research and preparation period, and one presentation period.

Materials:
Meterstick or measuring tape
Notebooks or clipboards with paper, preferably waterproof, and pencils for the field
12" x 18" drawing paper
Assorted colored pencils, pens, pastels, or crayons
Large piece of colored butcher paper (per group) to attach maps and drawings for completed visual presentation
Glue
Assorted plant and animal guidebooks or library

Procedure:

1. **Cooperative Groups:** Form cooperative groups and assign tasks to group members. Possible tasks:

- drawing a map of the area, including a key with scale
- drawing all of the significant plants seen
- drawing all of the significant animals seen, or listing all animal sign (spiderwebs, worms or beetles in soil, feathers, tracks, birds heard or flying over, etc.)
- listing all evidence of humans and how humans are known to use the habitat (picnicking, gathering eggs or berries, littering, driving off-road vehicles, bird-watching, fishing, etc.) Divide this information into lists of "destructive", "neutral", and "constructive" use.

2. **Field Trip.** Take a field trip to a local plant and animal habitat to research according to the above tasks.

3. **Research Time.** Allow research time for them to discover more about the habitat. This may be accomplished by looking up plant and animal names (older students), or providing time overnight to interview family members and local elders about the area (all ages). This should not be limited to only the individual task-holders.

4. **Presentations.** Allow class time for students to prepare their findings and organize their visual presentation by arranging individual work on a large poster. Don't forget to include the name of the habitat type in the presentation. Consider having students make their group presentations orally to the class.

- Activity -

MAP YOUR HABITATS

Grade level: 2 - 12

Objectives: Learn about the geography of your state or province. Explore the variety of habitat types and names found locally. Explore your local environment. Practice map reading skills. Practice observation and drawing skills.

Duration: One 30-minute class period, plus additional for "Extensions"

Materials:

Copies of blank outline map of your state or province, one per student
Textbook maps or copies of topographical or political state map, one per student or table
Felt tip pens or colored pencils

Procedure:

1. Pass out one copy of blank state map to each student.

2. Have students locate one each of as many of the following types of open habitat as possible on maps of their state (from texts, library materials, or copies of a map you hand out), and draw them in, labelled, on their blank maps:
   stream, river, lake, ocean beach, mudflat, saltmarsh, freshwater marsh, tundra, muskeg, ocean beach, open grassland, prairie, rocky and vegetated alpine (mountain tops above treeline)

Extensions:

1. **Local Maps.** After discussing the above results, choose one of the following:

   A. Rural students: Have students draw a map of the local area where their school and home is located. Label roads, paths, buildings, and all areas of natural or human-made habitat. (Human-made habitat might include gravel beds, sewer lagoons, or dumps. What organisms find food, water, shelter, or a place to breed in these places?) Give the most complete name or description possible for each habitat.

   B. Urban students: Pass out copies of a map or partial map of your town. Ask students to locate *as many examples* of the habitats listed in #2 above as possible. You may wish to have them color them in with felt tip markers or circle them.

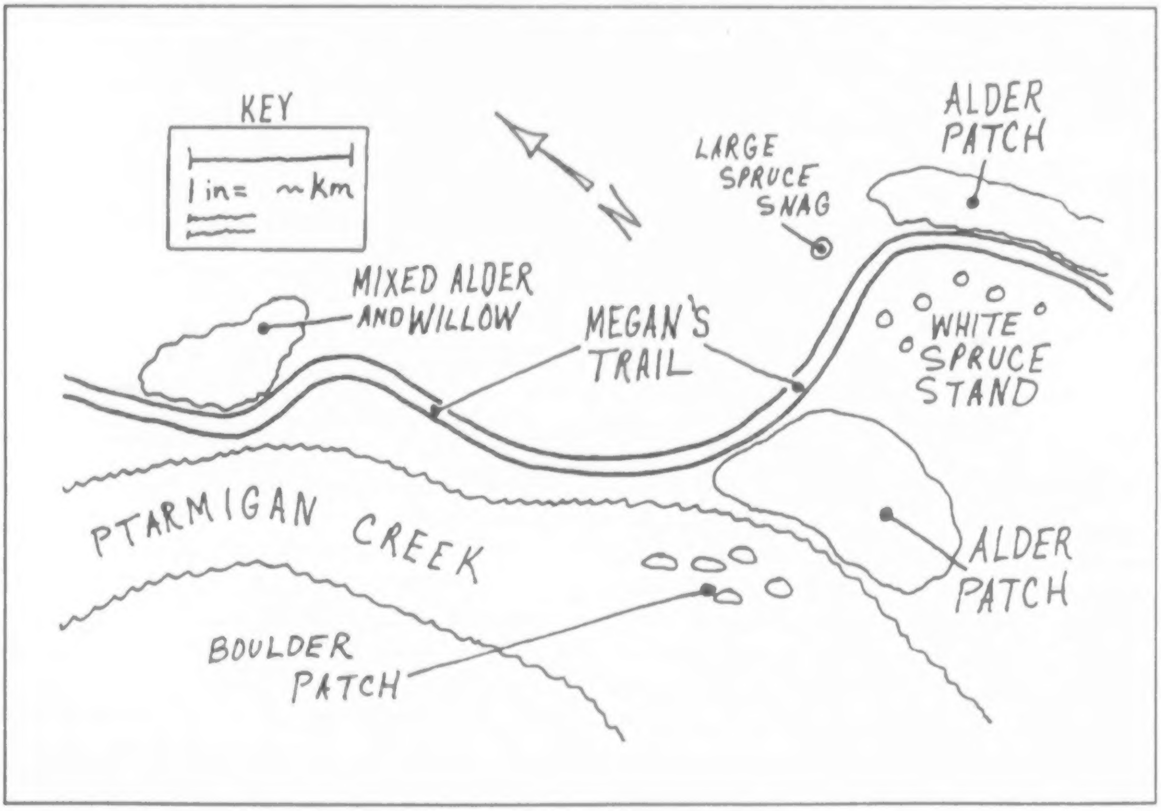
   C. Rural students: Have students draw a map of the area just around their home. How many bushes, ponds, areas of grass or gravel, etc., can they draw in by memory?

2. **Elder Interviews.** Have students interview local elders about names in their Native language or traditional terms for local habitat types.

3. **Outdoor Map-Making.** Using compasses and one or two 25 or 50-meter measuring tapes, making a map of a winding section of trail through a local park, field, or wood is a great outdoor math, metric, and geography activity.

First, perhaps in a preliminary lesson, introduce students to the use of a compass. (Compasses are available in inexpensive models, and usually come with instructions that will allow the teacher to brush up easily. Don't forget to tie each compass on a string so that the students can keep them around their necks.)

Provide students with clipboards with pencils tied to them. Provide them also with a list of requirements for the map (e.g. labels indicating lengths and directions; a certain number of landmarks and habitat elements like boulders, stands of trees or shrubs, or ponds, perhaps with measurements of their widths or diameters as well). Assign individualized tasks, and rotate them during the course of the activity so that everyone has a chance to work with the compass and work on the math and map calculations. Students should work in teams, so there is someone to hold the ends of the measuring tape, site with the compass, and write down compass readings. Students will need to confer to decide how best to draw their map as they make measurements and readings. It generally works best to have the students actually draw the diagram or map of the trail while they work, rather than take just measurements back into the classroom.



Sample Map of a Trail Winding Through Local Habitat

Require that they *label* on the map the measurements of each stretch and bend of the trail, and distances between any significant objects. This will ensure that they are not drawing merely by eye.

If the class is large or the level high, the teacher may choose to divide the class into cooperative groups which each draw their own map. They can then compare the maps and discuss accuracy and attention to various habitat details. Otherwise, the entire class can work together to produce one map. Different sections can be drawn simultaneously. Alternatively, the trail can be mapped simultaneously from the two ends by two different teams, and when the teams meet somewhere in the middle, students will have to work together to ensure that their joined maps coordinate accurately.

This mapping activity also works well as a theme or multi-disciplinary lesson. Possible **extensions** for science include assigning one team to identify plants, another to identify animal evidence (spider webs, tracks, hair, feces, etc.). A team may also search out and map evidence of human use, such as tracks, traps, litter, old cabin sites, vehicle tracks, or evidence of hunting or dog-walking etc..

Before going outside, don't forget to go over good field trip behavior. See the Teacher Information in the Field Trip chapter for topics to cover, such as safety, not destroying plants or disturbing animals, and being careful of where you step (nesting birds may sit very tight on hidden ground nests, for instance).

4. **Class Discussion.** The following questions may be useful in a class discussion:

- What lives here (around your home or in your town) besides you, and shares the habitat (finds food, water, shelter, a place to breed) around your house?

- Would your map of the local area look the same in winter? What would be different about the habitat that might not be reflected by the map?

- All of the habitats listed in #2 above could be classified as "open." Are they all suitable for shorebirds? Why or why not?

- Where in your state would you guess might be a good habitat for shorebirds during the breeding season? During migration? During winter?

- Did you see any official names of habitat, or do you know of any personally or locally, that don't seem to be accurate? Is it because a place may have changed over time?

- What terms not found in the list above do people use locally or traditionally to describe habitats? (Examples: "grass lake", "flats.")

- How many other terms for habitats can you find among place names on your state (or town) map? (Examples: "Shady *Slough*", "Dandelion *Meadow*", "Parker's *Knoll*.")

- Activity -

LETTER WRITING

Grade level: 2 - 12

Objectives: Practice written communication and, specifically, letter-writing skills. Learn etiquette skills relating to asking for information and thanking people who help you. Relate social and political events to scientific research. Older students will learn business-letter format.

Duration: One 30-minute class period

Materials: paper and pen (or computer), envelopes, addresses

Procedure:
Have students write letters concerning shorebirds and their wetland habitat. You might want to encourage students to *share* relevant information or relate experiences of their own, as well as *asking* for help. Some suggestions for letters:

> Write to penpals made through the Shorebird Sister Schools Program (see page 169).
>
> Research and write to the appropriate local, state, or federal regulatory agencies and land managers (e.g., planning and zoning boards, state departments of fish and game, and the U.S. Fish and Wildlife Service) asking for information on status (e.g. land ownership and resource-use designation) of local areas used by shorebirds. Older students should practice correct business letter format for these or letters-to-the editor.
>
> Write to elders asking for historical information concerning such topics as human use of specific habitat areas, interaction with shorebirds, stories about shorebirds, or Native names for shorebirds or habitat areas. Rather than expecting written responses, students might also inquire about the possibility of interviews.
>
> Write to elders, homes for the elderly, hospice patients, or shut-ins, sharing stories, field trip experiences, or information about shorebirds and habitat.
>
> Write "letters to the editor" on issues concerning local shorebird habitat.
>
> Write thank you letters to parent helpers, resource people, bus drivers, etc. following a field trip.

Adapted originally from Quinlan, Alaska Wildlife Week.

ADDITIONAL ACTIVITIES: *HABITAT*

1. **Field Trips. K-12.** The best way to study habitat, local and in general, is with field trips! See the *Field Trips* section (page 173) for activities and other ideas for helping students get the most out of exploratory visits in their natural environment.

2. **"Expand Your Habitat Horizons." 7-12.** (Particularly useful for inclusion with a **field trip** lesson.) Instruct students to each pick a shorebird that they observed. Write down a description of the habitat in which it was found. Given that habitat, the student's knowledge of geography, and a map or globe, have students make an educated guess (hypothesize) where else in the state they might find this bird, and where else on the globe it might be found. What factors (food and water availability, type of wetland, climate, time of year) did they take into account when deriving this hypothesis?

3. **Brainstorm about Human Habitat. 4-12.** The content objectives here are making connections between humans and their environment, learning about human habitat requirements, and studying the meaning of the strategy of *migration*. Have students brainstorm a list of all of the habitats that *they* depend on for their own food, shelter (rest), and water. Do they know where all of those places are located? Include or follow up with a discussion: What is the difference between *place* and *habitat*? What could you (students) live without? What would you rather not do without? Could you survive on only those elements which are available in your local habitat, or is some "migration" necessary? Do you or your family make any short or long-distance "migrations", and for what purposes?

4. **Relating Adaptation to Habitat. 3-12.** Ask students to come up with adaptations they think that they would need to make to themselves or to their lifestyles in order to survive in a specific shorebird habitat. For example, give them 10 minutes to brainstorm (alone or in pairs or groups) what modifications (snorkeling gear, clothing that is warm and waterproof, shovels for clam-digging, etc.) it would take to enable them to survive (eat, drink, rest) on an open ocean beach where the water comes in over their heads twice a day? (This question is asked in the reading "What is a Wetland?" found earlier in the Habitat chapter.) What sorts of thing do humans consider when making a decision about where to live? (Food source, clean water source, available hospitals and schools, jobs, ability to afford costs associated with an area, etc.)

5. **Creative Writing. 2-12.** Have students compose a creative story about something that might have happened on a particular, local, developed place (e.g., where the school now stands, or a street corner outside the school), 100 or 150 years ago (pre-development). Students should brainstorm ideas out loud ahead of time.

Alternatives: You may wish to have students write as individuals, groups, or a class. Story length should be one-half to one and one half pages, depending on time availability and level. You may wish to require certain habitat vocabulary words, but stress creativity in the story as well as concentration on what elements the place realistically may have contained. Would the habitat 100 years ago be like nearby natural habitat is now, or was it very different? How so? If students have already studied prehistory, dinosaurs, etc., you may choose to have the story take place, say, one million years ago.

6. **Creative Writing with Computers. 3-12.** Have students write a story as in #4 above, but modify: one student writes the original story, which is then passed on to other students to modify one at a time over a reasonable amount of time in which all students have had computer access. The story is either passed from student to student on a floppy disc, or by e-mail. When the last student is done, the final story is compared to the original. To ensure participation, each student must print out and hand in their story version. You may wish to instruct each student to change or add at least three to five habitat elements.

7. **"Round-Red Knot" Story. 2-6.** Instead of a "round-robin" story, have the students create a "round-red knot" story. Create a variety of prompting cards with habitat, migration, and shorebird terms/names on them, and deal out at least three to each student (duplicates are ok). The teacher, out loud, starts a story about a shorebird and its habitats with one sentence. (For example, "Raquel the Red Knot was looking across the sunlit tundra one morning.") Each student responds in turn with the next sentence, each time holding up one of his/her cards and using it in the sentence.

8. **"Habitat Card Bingo" Alternatives. 4-7.** *Alternatives to the activity on page 79.*

Alternative 1: Create a batch of cards with habitat terms (see "Match Your Habitat Cards" activity) on them. Write down the list of corresponding definitions on a sheet of paper for yourself. Deal out the cards, at least three each, to students (duplicates are ok). Read the first definition (definition *only*, not the term). Ask students to raise their hands if they believe they have the correctly matching term card. Have all students who guessed correctly turn their card in to the teacher. The first student to give up all of his/her cards wins.

Alternative 2: Create a batch of bingo cards with habitat terms in place of numbers. There should be cards with terms in a variety of orders. Don't forget to print the word "BINGO" across the top of the card. The free space in the center might be a little shorebird. Deal one bingo card and a dozen pinto beans or something similar to use as bingo markers. Randomly read out loud a letter in "bingo" plus one of the habitat terms (e.g., "N, wetlands"). Students who have that combination place a marker on the term. The first student who completes a row of markers, either horizontally, vertically, or diagonally, wins.

9. **Habitat Card Bingo Alternative. 6-12.** Prepare and play a bingo game as described in #7, Alternative #2. Modify it as follows: record a list of the definitions for the habitat terms for yourself. Instead of reading the actual *term* to the students, read them only the *definition* for the term. They will have to decide for themselves if they have the matching Bingo letter and term. For example, recite "'N' 'These are areas of land that are covered by water for at least part of the year'," for the Bingo letter "N" and the term "wetlands."

10. **Wetland Mural. K-6.** Have the class draw a wetland mural. First brainstorm a list of wetland habitat elements (abiotic elements plus plants and animals, including shorebirds!) on the board, so that students have specific ideas of what to draw. Unroll a long sheet of butcher block paper on the floor and provide colored pencils, crayons, markers, or paints.

11. **Guess the Place. 4-7.** This activity will encourage careful observation and consideration of habitat elements. In the morning, tell students to secretly think about a place in or around the school and how they would describe it. Later, after they have had a chance to be out of the room at recess or lunch, proceed with the activity: have each student describe their secretly chosen place to

the rest of the class and see if their classmates can guess where it is. Examples of places include inside the fish tank, a corner of the classroom, under the teacher's desk, the lawn next to the playground, the boys' bathroom, or the equipment room off the gym. You may also ask them to consider what organisms *inhabit* this place (microbes, fungus, spiders, birds, humans, a potted palm, grass, or moss), and include them among their clues for the class.

Research Ideas:

12. **Shorebird Species. 4-12.** Have students choose a shorebird species and find where it migrates to in summer (for breeding) and winter, and what migratory route it is known to follow. Is it a "short-" or "long-distance" migrant? What kind of habitat does it use in each area, and why? Have students use at least three sources and include in their write-up a comparison (e.g., date/age of publication, any bias) of their source information.

This will help with critical reading, comparison, and evaluation skills, because their sources may give at least slightly different information. What might account for these differences, and why is it important to consult several sources? How do you know what information to trust? The teacher may also elect to have students establish e-mail penpals with students in another habitat where the shorebird occurs. Getting involved in **The Shorebird Sister Schools Program** is a great way to help realize these objectives (see page 169 for details).

13. **Local Parks. 4-12.** Have students research to find what state or federal parks/refuges/nature preserves are in your state, province, or within 50 or 100 miles of your town. Ask them what animal/plant/habitat was the park created to protect. In which ones do you find shorebirds? Were you surprised at your findings?

14. **Thematic Units. 6-12.** One of the themes of this shorebird curriculum is the interconnectedness of the elements of our natural world. Shorebirds do not exist in a vacuum anymore than mathematics or the flow of water does. All of these elements, concepts, and ways of studying our universe are connected to each other or even dependent on each other.

As part of a thematic unit, or to incorporate information students are learning about such topics as geology, geography, general physics, meteorology, properties of water, or Western Civilization, have them research a particular local shorebird habitat site in terms of one of those topics.

> ***Examples:*** They may write a research paper (or make an oral presentation) on a local mudflat used by shorebirds *and* the geological history of that same mudflat. Research one of the following topics in terms of shorebird habitat: tides (What are tides and how do they affect shorebirds? Which shorebirds are affected?); water science (What is water? What are some properties of water? In what ways is water important to life? In what ways is water important to shorebirds? Compare and contrast freshwater and saltwater, and how various animals like shorebirds use these two types.); plant adaptations (How are plants adapted to their habitats? How do shorebirds use plants? What plants are important to certain shorebird habitats?); predation (What effects does predation have on shorebird habitat use or choice?); shelter; ecosystems; and energy/food web.

15. **Legislation. 10-12.** The Clean Water Act provides for federal protection of wetlands. Students can research this and/or state and local conservation legislation.

KEY WORDS: *HABITAT*

algae
decomposition
estuary
forage
freshwater marsh
intertidal zone
introduced species
microorganism
nutrients
phytoplankton
permafrost
population
preferred habitat
productive
runoff
saltwater marsh
upland
tundra
wetland

NESTING AND BREEDING

CONCEPTS:

- **Most shorebirds nest on the ground.**
- **Shorebirds have elaborate behavioral adaptations for courtship display and protection of their nests and young. The ritualistic behaviors of shorebirds are some of the most spectacular and complex of all the birds.**
- **Shorebirds defend breeding territories.**
- **Shorebird nests are well-camouflaged, and chicks use both camouflage and behavior to stay concealed from predators.**
- **The Arctic tundra is critically important breeding habitat for many migratory shorebirds.**
- **Shorebirds migrate to higher latitudes (like the Arctic) for breeding so they can take advantage of the summer's abundant source of invertebrate food items.**

NESTING AND BREEDING

Shorebirds, like most vertebrates, breed only during one particular time of the year. Shorebird breeding also incorporates rituals of behavior. Most breeding behaviors occur within the ***"breeding season"*** and on the ***"breeding grounds"*** (place where the species breeds). Arctic-nesting shorebirds must migrate north to these areas. Breeding behaviors there include establishing a territory, attracting a mate, courtship-displaying, copulating, nest-building, laying and incubating eggs, and rearing young, but not necessarily all in that order! If a shorebird population is going to continue to exist, all of these activities must be accomplished within the two short months of the Arctic summer.

GROUND NESTS

Protection of Nests

Arctic-nesting shorebirds generally nest on the ground. Most of these nests are simple-looking, shallow, saucer- or cup-shaped nests. They may be lined with grass or lichens. Some are made entirely of pebbles and a few bits of shells and are called ***scrapes***.

Nests in trees are concealed by leaves and protected from ground predators by their height, but there are very few trees in the Arctic! Ground nests are concealed by camouflage coloring; their simple and shallow structure; and sometimes small, nearby or overhanging plants. Shorebirds also help to protect their nests as they sit on them by the cryptic coloration of their own bodies. Sometimes both male and female take turns incubating, while in other species only the female or, occasionally, only the male incubates.

Parent birds are also known for their ***distraction displays***. The parent purposely draws the attentions of an intruder by calls or exaggerated movements. The parent may pretend to drag a broken wing or tail, hoping that an intruder will see the parent as easy, helpless prey and go after him or her instead of the eggs or chicks.

Shorebird chicks do not ***fledge*** (grow all their flight feathers and begin to fly) until about three or four weeks old. Newly fledged birds are called ***"fledglings"***. They have their own adaptations for protection in their ground habitat. They are colored "cryptically", so as to blend with their background. They are also adapted to freeze in place when the parent makes a certain alarm call.

Nest in Wetlands

Why do shorebirds build their nests in wetlands? Wetlands make wonderful nursery habitat for many animals. This is because of the abundance of food, shelter, and water available there: food is in the form of plankton, plants, and - important for shorebirds - invertebrates. The leaves, blades, and roots of diverse wetland plants provide plenty of substrate (something on which to cling or walk) and shelter for tiny invertebrates, as well as concealment for baby birds.

VARIETY OF MATING SYSTEMS

The variety of mating systems found among shorebirds is one of the largest among all the orders of birds. ***Mating system*** refers to the roles taken on by each breeding male and female. There are a variety of different possible mating systems among birds, and shorebirds are adapted to use many of them.

Monogamy

Many shorebirds are ***monogamous*** for the length of one breeding season. This means that each summer a female only mates with one male, and that male only mates with one female. The next summer, they will likely find different mates. Dunlins, Western Sandpipers, turnstones, yellowlegs, dowitchers, godwits and Red Knots are usually monogamous.

Why is monogamy such a popular mating system in shorebirds? One reason is because the chicks' survival chances will be increased when there are two parents protecting a nest.

Polygamy

Other shorebirds are ***polygamous***. This means that an individual breeds with more than one other mate during a given breeding season. Polygamy can be divided into two basic types:

Polyandry refers to one female forming pair-bonds with two or more males within one summer. The Red-necked and Red Phalaropes are two species of Arctic-nesting shorebirds which are famous for this unusual behavior. The females of these non-territorial little birds are also more brightly colored than the males, and the females are the ones to attract the opposite sex with special calls, flights and postures.

Polygyny is the type of polygamy in which one male maintains pair-bonds with at least two females in a summer. White-rumped Sandpiper males are polygynous, defending more than one female (and nest) on their Arctic tundra breeding territories.

Promiscuity and Lekking

Shorebirds can also be ***promiscuous***. Notice that polygamy implies some type of bond that lasted beyond the actual ***copulation*** (physical union of the female and male). Examples of such a pair bond would be helping to incubate the eggs, feeding the mate who is incubating, and feeding or otherwise tending to the chicks. Promiscuous individuals, on the other hand, copulate with more than one mate, but generally don't stick around to help raise the family. Female snipe are promiscuous at the beginning of the season, but when the nest site is chosen she forms a pair-bond with one male for the rest of the season.

In shorebirds, as well as birds like grouse, promiscuity often involves ***leks***. Leks are places where a group of males gather to make vigourous displays. These displays are designed to attract females for the purpose of mating, and this type of behavior is called *lekking*. Leks occur at specific sites which are traditionally returned to year after year. What would the advantage to that be? (increases chances of quickly finding mates.) Anywhere from two to 15 male Buff-breasted Sandpipers gather on broad upland tundra leks every year. They engage in rituals of wing-stretching, waving and jumping, as females gather. Imagine seeing the strange gathering: glinting, white underwings waving in the low, bright light of an Arctic dawn. Researchers believe the sandpipers choose to display at the time of day when their wings are most showy.

ELABORATE AND RITUALIZED DISPLAYS

Shorebirds have evolved some of the most elaborate and complex displays associated with breeding seen among all the orders of birds. Each step of the process of breeding is associated with interesting adaptive behaviors. These displays involve repeated, exaggerated movements and postures designed to draw attention to the gesturing bird.

While you are considering the following behavioral adaptations, think about what morphological adaptations may help shorebirds carry out the behaviors.

Mate-Attraction Displays

Upon arriving at the breeding grounds, males advertise themselves or the territory they have staked out around themselves. Their attempts to attract females may include dramatic aerial and ground displays and calls. Dunlin and Western Sandpiper males perform rituals of flight displays and song. The roles are reversed in polyandrous species like the phalaropes.

For many species, displays include wing fluttering, tail cocking, nest scraping, and other rituals. On the Arctic tundra, the male Pectoral Sandpiper draws attention to his fitness as a mate by an amazing pumping of a fat-filled breast sac, accompanied by exaggerated ***gestures***, loud hooting, and low-level flights. The same ritual is repeated by all breeding male Pectoral Sandpipers every year.

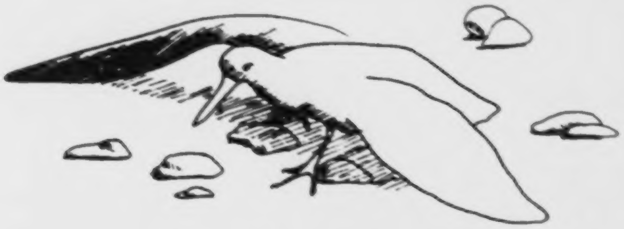
One of the most hauntingly familiar cries of the North American spring is the "winnowing" or "bleating" of the Common Snipe. Near open bogs, a musical wailing sound may seem to mysteriously come from the sky. He repeatedly flies high into the sky and then plunges straight down toward the earth before beating his wings to rise again. While doing this, his tail is held at such an angle, and the stiff feathers of it so constructed, that air rushing over the feathers produces the unique mating call. Be sure and listen for it this summer!

Courtship Rituals

Once the male shorebird is successful in his advertising display, the receptive female joins him in ***courtship*** rituals. These are gestures and activities performed between the chosen mates and generally lead up to copulation. The female responds with bows, tail movements, calls, or the way she holds her bill. Behaviors of the courting couple may include neck preening and calls. The courting ritual also involves nest building. Each shorebird species has its own peculiar ritual.

Distraction Displays

A distraction technique common to shorebird parents is the broken-wing act. A parent bird pretends its wing or tail is broken by spreading it out and dragging it along the ground. This is meant to attract the attention of a threatening intruder by appearing to be a desirable, easy-to-catch prey item. The intent is to draw a predator's attention away from the helpless eggs or chicks.



Broken-Wing Act

104

OTHER IMPORTANT BEHAVIORAL ADAPTATIONS

Territoriality

Mating Territories

Although a population of shorebirds may nest in the same habitat, most are not colonial breeders like seabirds. Instead, shorebirds behave ***territorially*** on the breeding grounds. The male stakes out an area for his female-attracting displays and chases out intruding males of the same species. Like most territorial vertebrates when faced with such an intruder, a territorial shorebird may direct a particular variety of displays (very different from those it uses to attract a female) toward the intruder before resorting to a chase or fight. What are the advantages of such displays over actual contact and fighting?

Nonbreeding Territories

Are shorebirds territorial during the rest of the year? Some species do defend ***home ranges*** (the specific area that a shorebird normally uses, particularly to find food, during its day or nonbreeding season). The same home range may be returned to each day and defended by the same individual throughout most of the season.

Alternatively, some feeding territories are *mobile*. This means that as the bird forages along the beach, it maintains a certain distance around itself where other birds of the same species aren't permitted to forage. The individual may use different areas, but insists on defending a certain amount of space wherever it is.

Defense of feeding territories, just as defense of breeding sites, involves a very *ritualized* (meaning consistent and predictable) set of display behaviors. Individuals will react to intruders by cocking the tail, marching, hunching the back, or running with a certain posture. These displays *escalate* in a predictable order and only evolve to chasing and, finally, potentially dangerous fighting if absolutely necessary.

Why Visual and Vocal Displays?

Why are displays effective? Displays often come before *escalation* to actual fighting. Visual displays permit the birds to communicate their ownership and intent-to-defend without the *risk* of physical injury. As to potential predators, shorebirds are relatively small birds, and can't effectively *fight* large predators off, and young and eggs can't fly. Their means of defense instead are distraction by the parent (who can protect itself by flight) and forms of camouflage or concealment.

Parental Roles Can Vary

Care of the eggs or ***brood*** (young chicks still under the protection of parents) are handled in different ways by different species. The female Bar-tailed Godwit incubates the eggs by day, the male by night. These roles are reversed in Dunlins. The female Black-bellied Plover deserts the chicks when they are only half-way to fledging, leaving the male to care for them. The Common Snipe pair divides its brood up and each parent cares for only some of the chicks. Chicks from unrelated groups of Least Sandpiper nests are moved to communal feeding grounds.

Care of the Young Ends

Length of care of the young varies among species. Oystercatchers (which are not high Arctic breeders constrained by weather) may feed their chicks for more than 100 days after hatching. In some species, one parent or another leaves the family before the young even fledge. In most shorebird species, the adults leave the breeding grounds and begin their fall migration before the chicks migrate a week or two later. Imagine if this week every kindergartener in your school had to find his or her way to Nicaragua without any parents or other adults! What would they need to find their destination safely?

Migration and Breeding Site Fidelity

Shorebird migrations provide us with one of the most visually spectacular displays of nature. Many shorebirds undertake long and arduous migrations to reach appropriate breeding grounds. For each population, these breeding grounds must be the same ones used traditionally year after year. Shorebirds are said to be very ***site-faithful*** because they return to the same breeding grounds, and sometimes the same territory. Oystercatchers will even use the same scrape.

IMPORTANCE OF THE ARCTIC TUNDRA

About one-third of the world's 214 shorebird species breed in the Nearctic and Palearctic. As we have mentioned before, the Arctic tundra provides sheltering and nutrient-rich wetland habitat. The unshaded low plants and nests found there among the tussocks are warmed by the low Arctic sun. One of the most obvious advantages that the Arctic tundra offers are the billions of insects that are hatched there each summer and available as shorebird prey. Growing chicks need a constant source of nourishment, and the insects provide this.

The tundra provides other resources as well. For instance, the summer diet of Ruddy Turnstones (which forage for invertebrates on open shores in the winter) may include a lot of berries and other tundra vegetation.

(For information on the breeding habitats of shorebird species, see Appendix E.)

SUMMER IS THE SEASON FOR BREEDING

In these activities, we often use the terms "summer" and "breeding season" interchangeably, and the same is true for "winter" and "nonbreeding season". Let's examine those terms for a minute. "Summer" refers to that time of year when our part of the globe is tilted closest to the sun, receiving the most hours of sunlight each day, right? There wouldn't be any *seasons* if the Earth wasn't tilted on its axis, (although the equator would still be warmer than the poles because it's closer to the sun).

When those of us in the north are experiencing winter (because our part of the globe is tipped away from the sun), our migrating shorebirds have flown south. We say that the birds are "wintering" in the south, now that their breeding is completed for the year. However, if those birds are spending their nonbreeding season south of the equator, as many do, it isn't "winter" where they are, is it? December and January, for instance, are summer months, not winter months, if you are south of the equator. Our winter months are the nonbreeding season of Arctic-nesting shorebirds, but they aren't spending them in the cold! Of course, not all animals breed in the summer. When do moose mate and have their young?

The summer is very short in the Arctic, and so breeding must take place efficiently and quickly. Having a common language or a set list of tasks helps factory workers get their jobs done more efficiently than they would if everyone ran around trying to do things their own way without recognition of other people or conditions. Similarly, using a system or ritual of behaviors helps the shorebird populations accomplish mating and raising chicks in the precious time that they have available.

- Activity -

GUARD YOUR NEST

Background:

Ground Nesting

Most shorebirds nest on the ground. Many shorebirds migrate long distances to the Arctic. During their migrations, these birds are seen making stopovers in huge flocks on ocean beaches and other wetlands. What are these stopovers for? ("Refueling": feeding or taking in energy).

They breed every summer in the north, in the high Arctic. They mate and make their nests there on open tundra. The nests are generally very simple-looking. They are shallow, saucer- or cup-shaped depressions hollowed or "scraped" into the ground. This is why the nests are often called *scrapes*. Not only shorebirds, but ptarmigan, grouse, and some ducks also make scrapes. Black Oystercatchers make gravel scrapes on the beach. Shorebird nests may be lined with grass, leaves, pebbles, or bits of shell.

Importance of Arctic

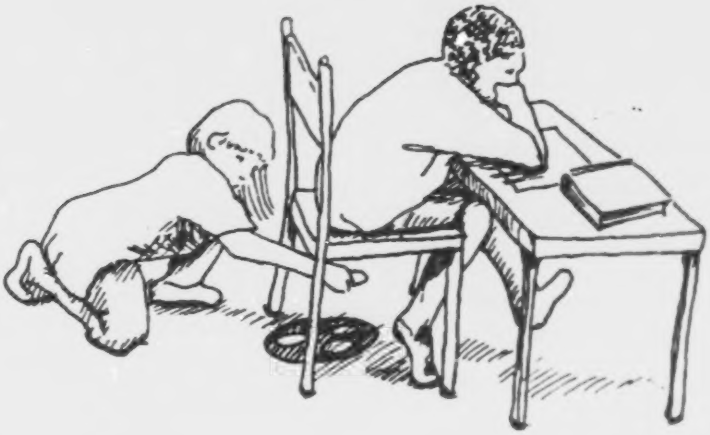
Shorebirds that migrate to the Arctic do so to take advantage of a huge food supply for the chicks they will hatch. What kinds of foods appear in the Arctic in the summer? Clouds of insects! Insects are hatched in the tundra wetlands by the billions each year. These and other tiny invertebrates provide nourishment for the growing chicks and hard-working parents. Seeds and berries also become available to birds in the Arctic summer.

Methods of Protection of the Nest and Brood

Shorebirds protect their nests in a variety of ways. Nests are concealed and made of material from the surrounding landscape. The eggs are camouflaged as well by their speckled coloration. Incubating parents have plumage which is cryptically colored (camouflaged by pattern of colors) and they sit very still on the nest so they will not attract attention if predators near.

Shorebird parents are particularly known for their clever displays when intruders threaten. One or both parents distract the intruder by pretending that they have a broken wing or are small mammalian prey. By these wing-dragging, hunched, or stiff-walking gestures, they attempt to lead the intruder away. As though these distraction behaviors for nest protection aren't elaborate enough, shorebirds are also known for their use of exaggerated gestures in courtship.

After the chicks are hatched, they learn to drop into a prone position at a parent's alarm call. This quiet, flattened posture helps conceal them. Their cryptic coloration, matching the background of their gravel or grassy nursery, also helps protect them from being noticed by hunting predators. Which of the adaptations for survival discussed above involve *behaviors* and which involve *physical* traits of shorebirds? Which involve both?



Grade level: 2 - 7

Objectives: Learn that many shorebirds build shallow nests on the ground. Learn about Arctic predators and threats to the nests of shorebirds. Explore the difficulties of protecting offspring. Learn that shorebirds protect their nests with such techniques as camouflage and with behaviors such as distraction displays. Practice critical thinking skills.

Duration: 20 to 30 minutes of preparation and post-activity discussion.
Plus one full day or class period of at least one hour. The activity will proceed *during* other lessons of the day:

Suggestion 1: Allot one to two hours to carry out this activity. Along with the activity, assign one or two lessons (such as readings, drawings, or worksheets which can be completed *with some disruption* and are due by the end of "Guard Your Nest." Other activities may also proceed during this time. Ideally, allow students to work together on some of these activities, so that some talking and moving about is o.k. "Guard Your Nest" may also proceed during a study period or "make-up" period.

Suggestion 2: Teachers who choose to make this an all-day activity may wish to set guidelines for when the game *cannot* be played, length of egg-taking attempts, etc.

Either way that you have students relax into a more natural state, have other activities to perform (just as nesting shorebird parents need to feed and preen, and predators have to care for their own young, etc.) besides guarding and attacking nests. Be sure and allow time after the activity for discussion.

Materials: construction paper (white and assorted colors) or paper plates
scissors
masking tape
crayons or colored pencils
Threat Cards, as prepared below
a lesson plan for activities which will proceed in class simultaneously

Teacher Preparation:

Prepare "Threat Cards." Make enough cards (duplicates are o.k.) so that they number one-third of the class size.

Procedure:

1. **Build Nests.** Have each student construct his or her own simple shorebird scrape and eggs. The nest should be either a paper plate or a circle-shape of about 6" diameter cut out of construction paper. Each nest should have 4 eggs (shorebirds tend to have 4-5, or occasionally 2-6). Students should cut small egg-shapes out of construction paper, taking care to make sure that all eggs fit within the diameter of the nest, touching but not on top of each other. Do not glue or tape eggs on to nest.

2. **Brainstorm Threats.** Have students brainstorm out loud about what they think are possible threats to shorebird nests in the Arctic. (See the "Discussion Questions" section at the end of this activity for more information on possible threats.)

Possible threats to shorebirds:
predators such as: humans, foxes, weasels, gulls, hawks, ***jaegers*** (pronounced "yay-ger", these are gull-like birds which nest in the Arctic and prey on other birds and eggs for food. Because of their notorious habit of ***piracy***, these northern seabirds make interesting study subjects for students.)

inexperienced parents, who build their nests in dangerous places or don't know how to defend them
flooding
extra-high tides or dangerous waves
humans (Besides purposeful ***egging*** or hunting, how else can humans be a threat to ground nests?)

3. **Object of the Game.** Every student is going to be a "Shorebird" and start with 4 eggs. Explain that the object of the activity is for each student to protect his or her eggs as best s/he can, and have as many eggs as possible left at the end of the day. Methods of protection may include anything except actual physical touching of the intruder, and as students brainstorm or discuss these methods, the teacher may choose to jot a list of them down on the board or a large piece of paper in order to serve as a reminder during the activity.

Possible methods of nest/egg protection:

hiding the nest

making the nest and the eggs the same color as their surroundings

staying very close to the nest so as to be aware of any danger that approaches

sitting very still and trying not to draw attention to yourself and your nest

directing gestures at any threatening predator in such a way as to distract them from your nest (for the purpose of this activity, vocal calls may be considered as part of a distraction display, although they are not always present in actual shorebird distraction)

distracting intruders by leading them away from the nest with some gesture or even pretense

4. **Explain that threats occur.** Tell students that several of them are going to receive a card with the name of a threat to shorebird nests on them. If they receive a card, they must attempt to "attack" one nest by following the instruction on the card. The cards will instruct them to "attack" in one of three ways: attempting to take one egg, all the eggs, or the entire nest with all the eggs.

Threat Cards:

Small Predator/human cards (weasel, hawk, jaeger, gull, or human) will allow the card-holder to take one egg from one nest.

Large predator cards (fox) will allow the card-holder to take all the eggs from one nest.

Flooding, high tides, and ATVs (all-terrain vehicles) will take the eggs *and* nest of one bird.

Rules for Threat Card-holding students:

Card-holders have all day to attempt to perform their attack, but they can only take one egg or nest, and must turn in their card to the teacher as soon as they are successful. They *cannot touch* the parent bird! Why not? (The parent can do something the eggs cannot - fly.) The teacher may or may not choose to then hand the card, secretly, to another student. Attacks cannot be done during periods when the class is leaving or gone for recess, lunch, etc.. Remember, students who receive cards to act as a threat are *also* still nesting shorebirds who need to protect their own nests.

5. **Rules for all students ("Shorebirds"):** If a bird senses an attack coming, s/he can protect it anyway s/he can think of *without touching* the card-holder ("Threat"). S/he also cannot pick up the nest. Birds may try to distract the Threat by talking to s/he, pretending to do something which distracts, or gesturing in some wild way. Perhaps a shorebird can distract the attacker long enough until the Threat has to turn his or her attention elsewhere. Students can develop their own methods, trying whatever works, within the guidelines.

6. **Consider where the nest should be built.** Instruct students to carefully consider where they should place their nest for the remainder of the period or day. It must be somewhere on the floor or a countertop, but not up high on top of cabinets (with older students, you may wish to set a limit of one meter from the floor). Tell students that the nests cannot be moved after they are originally placed.

7. **Time to work on improving nests.** Provide time for nest placement, and also for students to color their nests and eggs differently if they have decided that their nests should be better camouflaged. Have students fix their nest (but not their eggs!) in place with a loop or two of masking tape.

8. **Assign other work.** Hand out reading or worksheet assignments to be completed by the end of the "Guard Your Nest" game.

9. **Assign Threats.** In the next 5 or 10 minutes, quietly hand out the Threat cards so that about one-third of the class obtains one.

10. **Begin!** Let the activities proceed for the alloted time, giving all students a chance to be a Threat.

> ***Examples:***
> Mona receives a Threat Card that says "ATV." She watches for a good opportunity to attack an unguarded nest. Ten minutes later she notices that Daniel is across the room sharpening his pencil so she snatches all of his eggs. He had 8 because he had earlier been a "flood" and picked up Keith's 4 eggs. Daniel comes back to discover his inattention has cost him all of his eggs. Mona puts all the eggs in her own nest and hands the card to the teacher, who later passes it to Sylvia. Daniel asks the teacher for more paper to make 4 new eggs.
>
> Archie receives a Threat Card that says "jaeger." He watches for a good opportunity, and five minutes later sneaks up to snatch an egg from Chad's nest. Chad and Larry see him coming their way and decide to distract him by asking him about last night's basketball game or helping him with his assignment. To Chad's disappointment, Archie picks up one of Chad's eggs anyway, and puts it in his own nest and hands the card to the teacher. Chad may remember that he can choose to make another egg.

11. **Tally up.** When the activity is over, ask students to count their eggs.

12. **Possible post-activity discussion questions** follow:

- Was the color of your nest important? Could you have concealed it better? Would you have chosen a different habitat?

- Did you lose time making a new nest or new eggs? Is time important to shorebirds? (Yes, the Arctic summers are very short.) What might keep a second brood from fledging? (Insect bloom dies off, weather changes, parents have to migrate.)

- Are humans effective predators? (Yes.) Why were human predators allowed to only take one egg? (Humans who egg frequently leave some eggs so that more shorebirds will be born. Leaving eggs from as many nests as possible increases *genetic diversity*.)

- In what other ways can humans pose a threat to shorebird nests? (They may inadvertently drive over nests on the beach or tundra with ATVs. Researchers and other people who find nests can leave a scent trail. Because weasels can follow your scent and ravens and magpies sometimes look for nests by watching people, if you find a nest, walk on past it in the same direction you were going when you found it. Don't leave a "v-shaped" scent-trail.)

- Why are the predators present on the tundra? (Supply of eggs and chicks for food. Other birds, such as seabirds and waterfowl, also take advantage of this food by nesting on the Arctic tundra in the summer.)

- What happens to the nest if parents are killed? What could kill them? (Attacked when sitting tenaciously on nest.) Why are the parents in less danger of mortality than the eggs or chicks? (They can fly, and they are experienced at avoiding predators.

- Did you see any displays of *cooperation* (one shorebird helping another to distract a predator) among your classmates?

- Did you draw attention to your nest by gesturing when you saw a predator before s/he saw you?

- Did distraction work? (Often not, even with predators.) Why? (Card-holding predators wanted the egg more than whatever else was offered.) Why has it developed in birds? (A predator may be fooled into thinking that the distracting parent bird is a helpless, injured prey item that it can snatch as easily as an egg.)

- Activity -

BEHAVE YOURSELF!

Background:
Shorebirds are renowned for their use of very elaborate gestural behaviors. Some of these displays are *aerial* (performed in the air), while others are performed on the ground. Shorebirds engage in these complex displays for a variety of purposes. The most spectacular, sometimes involving plunging and hovering flights accompanied with trilling, hooting, or buzzing songs, are used for the attraction of mates, courtship with the chosen mate, and protection of nests and young. They are also performed as acts of aggression, particularly in territorial defense. Most shorebird species defend breeding territories, and many also defend winter feeding territories on the nonbreeding grounds.

Gestural and vocal displays are a vital form of communication among shorebirds. Repeated, commonly understood rituals help shorebirds to quickly let others know of their intentions on the breeding grounds, so that breeding can be accomplished among the most fit mates as efficiently as possible during the short Arctic summer. Territorial displays also allow birds to communicate their defense of or retreat from a boundary line without risking injury by actually fighting.

Grade level: 2-8

Objectives: By playing an active game in which one half of the class performs typical shorebird gestures while the other half tries to recognize them, students will learn that shorebirds communicate with a vast array of elaborate gestural displays. Learn that shorebirds use these displays for a variety of purposes. Some of these gestures are visual, others vocal.

Duration: One 30 to 40-minute class period.

Materials: Set of Behavior cards (see "Teacher Preparation," below)
Set of Charades cards (see "Teacher Preparation," below)

Teacher Preparation:

1. **Make Behavior cards.** On each card list a different combination of three possible shorebird actions and/or sounds. Make each card a *duplicate*. Make additional pairs for large classes or more variety by choosing different combinations of terms. A list of shorebird actions follow.

> ***Note*:** Cards may be printed with one action or sound in large letters at top so that leader can quickly remove some pairs and add new ones when shuffling between rounds, achieving more variety.

Ideas for Behavior Cards (list 3 on each card and make duplicates of all cards)	
Possible Actions	Possible Sounds
wing flash, wing spread, droop wings, dance, jump, hop, hunchback walk, stamp feet, stretch/extend neck, draw head down into shoulders, flutter wings, chase, zig-zag chase, hover, teeter, crouch, scrape (kick backwards), walk stiff-legged, rotate body (around which axis?), bow, beat wings slowly, beat wings rapidly, wing-vibration, open bill, lunge head first, dip-shake, rear up and spread wings, food exchange	whistle, hum, hoot, high trill, laugh, chatter, call loudly and endlessly, gurgle (gargle), purr

Examples of Behavior Cards:

Wing Flash
bow
hoot

Purr
stretch neck
walk stiff-legged

2. **Make Charade Cards:** Use index cards or laminate pieces of paper. These cards should *not* be in duplicate pairs. On each card print one of the following sentences:

Ideas for Charade Cards	
I am a wounded rabbit and you can catch me.	Our chicks (babies) are hungry.
My leg is broken and you can catch me.	I see a fox.
Come catch me: I'm a little mouse.	I like you
Where do you want to build the nest?	Come back here, Kids!
I am going to migrate south now.	Get down, Kids!
I am going to attack you.	Get out of here!
I am retreating (running away) from you.	I am thirsty.
You are in my territory (home) and I want you to stay.	My eggs are gone!
You are in my territory (home) and I want you to leave.	Look at me!

Procedure:

1. Have students stand in two lines facing each other (Lines A and B). If there is an odd number of students, teacher joins one line.

2. Select from the Behavior cards as many pairs of duplicates as there are pairs of students

3. Pass out a Behavior card to each student in Line A, and mix up and pass out the duplicates of those cards to Line B. Let them each look at their own card, then take them away. Line A students can huddle and ask each other for help reading or understanding cards, and Line B students can do the same. (Don't let Line A see B's cards, or vice versa.)

4. Tell the class that Line A students perform the actions and Line B students try to find the person performing the actions listed on his or her own card. The object of the game is for each student in Line B to observe and locate as fast as possible the matching Line A student. The performing students need to exaggerate their gestures and make their noises loud so as to be attention-getting! They keep repeating their three actions over and over until they are recognized.

5. Give a signal like "Behave yourself!" to prompt the Line A students to all begin repeating their three actions, while the Line B students observe.

6. Round ends when all Line B students have found the performance that matches their cards.

7. The last pair to match (or the first, see below) receives a Charade card from the teacher. They perform the action on the card, attempting to get the class to guess their sentence. Unlike in adult charades, it is not necessary to guess the exact words, only the general meaning. The pair can first have a moment to discuss their actions, and have the teacher help them if necessary. Give class a time limit for guessing.

Notes: 1. Sometimes have the first pair to match do charades, other times the last, to ensure that all students get a chance to do charades. Make 2 cards which say only "first" and "last". Before each round, have a student pick one without looking, and put it face down on a desk until the round is over. Keep track of who matches first and who matches last. Turn the card over when all have found their matches. (Alternatively, use "first" and "third").

2. If a reward for the charades performers is desired, the first matching pair gets to give another charades card to student of their choice if the class correctly guesses their charade. Alternatively, the charades-pair can pass out the next round of cards.

8. Have Line A and B students exchange places, shuffle the cards, and repeat until all students have had a chance to perform displays and charades.

Extensions:

1. **Also suitable for Smaller Classes (fewer than 10):** With the students in a circle, use the actions as a warm-up or "energizer" activity, or as a "Simon Says" game, and then play charades afterward.

2. **Escalating Confusion. Grades 5-8.** Escalate the complexity of the action by starting with two actions and moving to three to four to five. To simplify card-handling so that the game moves quickly, have students make the matching card pairs for each round: write all the actions on the board for students to choose from. Hand out small blank squares of paper to all students (you may want to hand a bundle out to each student ahead of time). Have students each quickly and secretly choose 2 actions from the board, and then write down those 2 actions on each of two pieces of paper. Collect these pairs of papers from every student, shuffle and hand out. For the next round, have students choose 3 actions and write those 3 down twice, on two pieces of paper. Continue as above.

3. **Male and Female Behavior. Grades 4-8.** To increase realism and relevance to shorebird breeding biology, label the displaying line of students "Males" instead of "Line A," and the observing line "Females" instead of "Line B". Periodically alter the roles by announcing that the class is now playing the part of a polyandrous shorebird society, and have the "Female" line perform the gestures.

- Activity -

YOU BE THE SCIENTIST

Background:
In science, if you want to answer or propose a theory to help answer the questions "why?" or "how?", it's important to have a good study *plan*. The ***Scientific Method*** is the framework that scientists use to form a study plan when they are trying to answer questions about our Universe. You are probably already familiar with this method.

The Scientific Method involves making observations and forming a ***hypothesis*** about a question you wonder about as a result of your observations. For example, you watch shorebirds feeding and wonder if the males feed in different places than the females. You guess that they don't feed separately (this is your hypothesis). Unfortunately, you aren't a shorebird and you can't tell the males apart from the females by watching. You need a plan to prove or disprove your hypothesis. Whether you are right or wrong isn't the point. You just want to know the answer.

A plan involves a list of *procedures* you will carry out to answer your question, and a list of *materials* you need in order to carry out that plan. You also need to decide how to present the *results* of your procedures - by table, graph, or pictures. Then you actually follow your procedures, write down your results (or *data*), and come up with a *conclusion* which answers the question you started with based on your results. Your method, or plan, must be something that can be repeated by another person, so s/he can verify your work and decide for herself or himself if you came to the correct conclusion.

You have hypothesized that there is no *sexual segregation* of shorebirds while feeding. Now, what is your plan? First you have to tell the males and females apart. One way to do this is by color-banding. Color-banding involves catching the birds alive in nets. The sex of a bird can be determined when it is "in the hand" by taking certain measurements. Once you know the sex, the birds can be banded with color-coded leg bands which can be distinguished by observers at a distance. Let's say you decide to put green bands on the females and red bands on the males. To make sure that you do not harm the birds, you must have training and permission to band. As a matter of fact, if you don't already have those, they might be the first steps of your procedure. After deciding how to tell the sexes apart, design a plan for observing the birds and recording who is eating where. Where, when, and how will you make your observations? How will you record your results?

After you have completed this study plan on paper, go out and do it! Follow your procedures and gather your data. Perhaps you will find out that the sexes do forage separately (your hypothesis is disproved). Perhaps you won't be able to come to a conclusion based on your data because there were problems with your plan or your data didn't provide you with a clear answer. The important thing is, you will find that you learned something by gathering the data, and perhaps you can now come up with a better plan and try again. Communicating with other scientists or observers might help.

Often, your plan needs to take into account a variety of ***variables***. This is especially true in biology, because living organisms do not exist in a vacuum - they are part of an ecosystem, and their lives are affected by many living and nonliving components of their environment. What are some examples of factors, *biotic* and *abiotic*, in your environment which affect your life? (Air, pollution, kinds of food available, your parents or people you live with, etc.) Some variables that might affect your shorebird experiment or conclusions include time of year, species, weather, or food availability.

Breeding involves complex physiological and morphological and behavioral adaptations. Because there is such a variety and complexity, it is an ideal subject to use for this activity exploring the questions "why?" and "how?". You could also do this activity using the topics of general adaptations or migration.

Grade level: 5 - 12

Objectives: By brainstorming about experimental plans and generating a class forum discussion, students practice and demonstrate skills of critical thinking, cooperation, and oral presentation. Explore possible theories about shorebird adaptations and breeding biology. Learn about the scientific process and practice developing experimental procedure.

Duration: One 40 to 50-minute class period.

Materials: Set of cards, made according to the instructions below.

Teacher Preparation:

Make a set of cards by writing the following questions, one per card, on 5"x 7" index cards: (For older students, write the questions in the form of a hypothesis. An example is given for the first sentence).

Questions:

- How could you show that a species was territorial or not?
  (Dunlins are territorial. How will you determine if this hypothesis is correct or not?)
- How could you find out if a shorebird's territory was three-dimensional (like a polygon) or two-dimensional (in a line along the beach, for instance)?

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- Devise a plan to find out if female shorebirds are territorial.
- How could you measure the size of a home range or territory?
- How could you find out what a shorebird eats?
- If studying nests, how could you keep predators from following your scent to the nests?
- How could you find out the percentage of breeders vs. nonbreeders in a shorebird population?
- How could you find out if a population of shorebirds comes back to the same place every year?
- How could you find out if there is a greater *diversity* of breeding shorebirds in tundra or coastal marsh?
- If there is a greater diversity of breeding shorebirds in tundra than elsewhere, why?
- Scientists believe that shorebird eggs are shaped the way they are so that heat loss is minimized when the eggs are laying next to each other in the nest. How could you prove or disprove this theory?
- How could you answer the question "are shorebirds *sexually segregated* when feeding?"
- How could we find out if plastic leg bands interfere with the bird's life (flying, walking, feeding, or mate selection, etc.)?
- How could we find out if oil development on the Arctic breeding grounds is affecting (positively or negatively?) survivorship (of chicks to fledgling state,) or mortality (death rate) of chicks, or population of breeders.
- How could we find out why a population of migratory breeding shorebirds is declining?
- Shorebirds are breeding nearby but not in one particular muskeg area that looks like good habitat. How can we find out why?
- Migrating shorebirds stop at the Copper River Delta by the millions during spring migration. How can we find out why?

Procedure:

1. Push desks aside and arrange the students and their chairs in a circle.

2. Form cooperative groups of two by either having students choose partners, numbering off, or otherwise choosing pairs.

3. Have each pair ("team") choose a card (without reading it first).

4. Allow ten minutes for the teams to prepare answers to their questions. Write prompts for the following guidelines on the board: Each team needs to come up with a procedure of at least 5 steps. They also need to include when and where (time of year, and possibly time of day or tide, etc.) their observations or experiment will be performed.

5. When all teams are ready, have them one at a time stand up, read their card, and present their study plan to the class, using the board.

6. After each presentation, have the students ask the rest of the class for their response. Do classmates think this would be a good study plan, why or why not? What would be better? Give extra credit to students who ask serious questions or come up with a thoughtful response.

Hints:

1. Tell students that the response "look the answer up in a book" is not a sufficient study plan because the answers are not yet known for many species.

2. Many questions, especially the "why?" questions, may never be completely answered. Remind students that the object of *this* activity is to figure out *how* they would go about trying to answer that question if they had to (which they do!). The activity can be altered effectively in a separate round by asking students to propose answers or theories (see "Additional Activities" below).

3. Below appears a few methods or ideas that students might incorporate and expand on (explain how they would accomplish these) in their responses. There are countless other ways to respond to the questions, and students should be encouraged to be creative.

Literature research/interviews (found out what is already known)
Captivity experiments (on organisms brought into the laboratory rather than observations made in the wild, natural habitat, or "field")
Dissections
Banded or marked birds
Observations
Censusing (counting)
Transects (extrapolating from what is found in one area)
Average a number of observations together
Compare seasonal data or annual data to show changes or trends
Present results as a bar, line, pie graph (*example:* comparing the diet of Dunlin and Western Sandpiper, with percentage of worms in diet as Y-axis and bird species as X-axis).
Constraints of the Theory of Natural Selection

Additional Activities:

1. **What Are Your Questions? 4-12.** Have students brainstorm and determine the questions they want answered. Next, they can devise study plans.

2. **Develop Hypotheses.** Instead of devising *study plans*, use this activity format to have students develop and present *hypotheses* or *possible theories* (i.e., answers) to science questions. This works well for thematic units. In other words, students can use what they have learned about such things as the laws of physics, mathematics, properties of water, gravitation and tides, evolutionary biology, physiology, or resource management to propose answers to questions about, say, shorebirds!

Examples:

1. Why do shorebirds which breed in the far north latitudes tend to be [illegible] in their breeding distribution (breed on more than one continent or in different hemispheres of the globe)?

2. Say Daniel counted 56,800 Western Sandpipers on the peak day (most birds) of spring migration on a beach in the Copper River Delta. In the fall he counted 783 on the peak day. How many were missing and where did they go?

3. **You Be the Scientist, Part II.** Have students do projects a) researching the answers to the questions, or b) writing a paper, based on research they do, on a good study plan.

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- **Activity** -

BUBBLE MAP

Grade level: 4 - 12

Objectives: Learn about the important elements involved in shorebird breeding. Practice critical thinking skills by exploring the many ways different elements of shorebird breeding habitat are related to one another. Reinforce the interconnectedness of an animal's behaviors, breeding biology, and habitat.

Duration: One 30-minute class period

Materials: Chalkboard
Blank, unlined 8½" x 11" paper

Procedure:

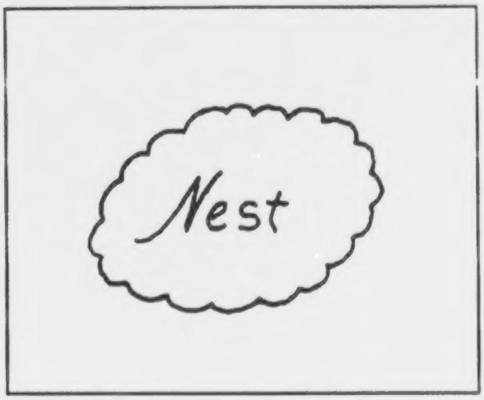
1. Ask students to close their eyes and imagine that they are shorebirds flying in to Arctic breeding grounds. Imagine to themselves what they see around them (what is the environment like and what animals besides themselves are there?). Ask them what they are doing. What will they do next? What else is happening there with other animals (plants, the weather, etc.) as they look about?

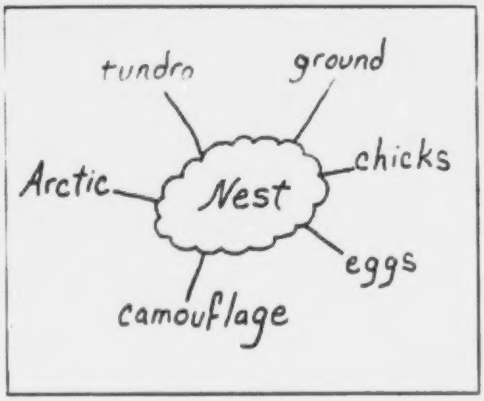
2. Next, have students brainstorm out loud a list of terms for or describing something about shorebird nests and nesting/breeding behaviors and methods. Encourage them to think about both "nouns" and "verbs" (actions). When you have 10 - 12, stop.

3. Ask students to brainstorm sentences which have to do with shorebirds and which connect two of any of those terms. Continue until every term is included in at least one sentence.

> *Examples: Camouflage* is one method of *protection* for *chicks*. Many shorebirds build their *nests* on the *ground*. *Predators* like foxes look for *eggs* and chicks.

4. Hand out an unlined 8" x 11" piece of paper to each student. Tell students that you would like them to arrange these terms and others into a *Bubble* or *Concept* Map. Such a map shows the *connections* between the ideas on your list. Mapping these ideas means showing how they relate to, are part of, or sometimes depend on, each other. The bubble drawn around each term represents a sphere to which a huge number of lines of connected terms can be drawn. Such an exercise shows us how one element can affect many animals or behaviors. Conversely, it can also show how many environmental factors depend on one particular other element. It is like a food/energy web, but includes many elements besides just producers and consumers.

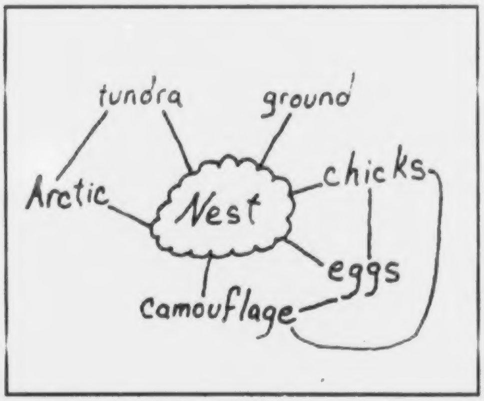


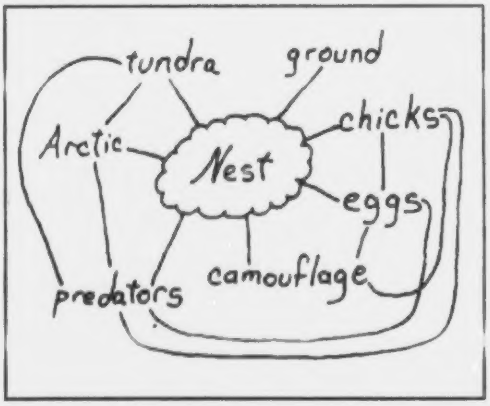

tundra
ground
chicks
Arctic
Nest
eggs
camouflage

5. Instruct students to write the word "nest" in the center of their paper. Tell them to draw a balloon or bubble around it.

6. Ask the class which of the other terms (See "Guidelines" below) they think is related to "nest." (In other words, what terms are important to shorebird nests, describe them in some way, tell about their location or what they're made of or who makes them, etc.)

7. Using the class's suggestions, draw an example of the beginning of a Bubble Map on the board. Start with writing some of the students' suggested terms around the "nest" bubble, and drawing lines connected from them to "nest."


tundra
ground
Arctic
Nest
chicks
eggs
camouflage


tundra
ground
chicks
Arctic
Nest
eggs
predators
camouflage

8. Draw additional lines showing other connections between the terms.

9. Next, write another term on the board and draw lines making appropriate connections between it and a word or words connected to "nest."

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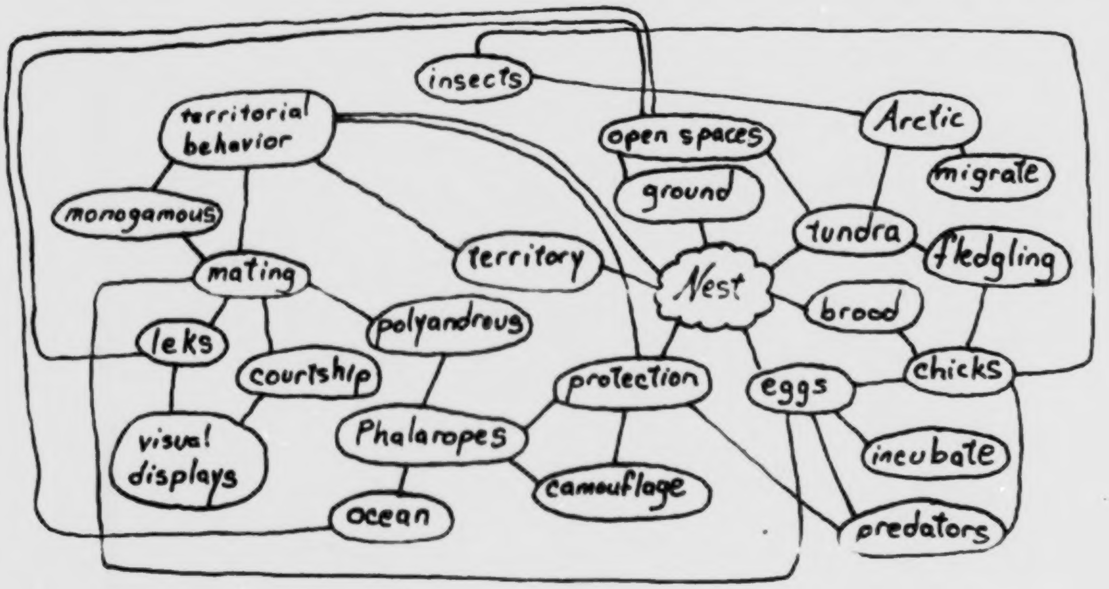
122

10. Instruct students to complete their own Bubble Maps using all the terms listed in the "Guidelines" posted on the board (see below). They should examine each word, decide for themselves (from the other terms) what other word or words it relates to, and write it down, drawing connecting lines between them. *Stress that everybody's map is going to look different*, and there are no wrong answers as long as they consider their connections carefully.

Note: With older students you may choose to demonstrate what a bubble map is on the board by using a different subject other than shorebird breeding. For instance, have a student volunteer his/her name, and draw connecting bubbles of terms that relate to him/her, like "soda pop," "basketball," "parents," his/her birthplace, etc.

11. Post the following **Student Guidelines for the Bubble Map** on the board:
    - Start with one central bubble which says "Nest" and build from there.
    - Include the terms *Arctic, migrate, open spaces, camouflage, visual displays, mating, and territorial behaviors.*
    - Include all of the terms written on the board (from group brainstorm session in #2 above).
    - Include at least 3 other terms of your own.
    - Each term must be connected to (related to) at least one other.
    - Be able to explain all connections (as in the sentences formed while brainstorming above).

Example of a Completed Bubble Map (note that many other lines could be included here):


insects
territorial behavior
open spaces
Arctic
migrate
ground
monogamous
tundra
fledgling
mating
territory
Nest
brood
polyandrous
leks
courtship
protection
eggs
chicks
visual displays
Phalaropes
incubate
camouflage
ocean
predators

Extension:

Human Habitat as Theme. Have students draw another Bubble Map, this time based on brainstorming about "humans" and *their* habitat. Alternatively, the central circle (theme) can be their own name. Try constructing a bubble map about "shorebirds" using only action words, rather than nouns.

- Student Reading -

GEE WHIZ FACTS: *EGGS AND NESTS*

Did you know that.....?

Egg laying by sandpipers in the Arctic is timed so that hatching will occur when the main hatch of insect food also occurs, thus providing the growing chicks with an abundant insect diet.

Some sandpipers in the Arctic ingest lemming teeth as a source of calcium for egg shell formation.

The calcium content of the shells of a four-egg sandpiper clutch is greater than the calcium content of the female which laid the eggs.

Western Sandpipers weigh about 25 grams (less than 1 oz.). They lay four eggs, and each one of them weighs 7.5 grams. That's almost 1/3 of the female Western's body weight *per egg*.

Biologists think shorebird eggs are pointed on one end so that they can fit together smoothly in the nest in a pinwheel shape. When the parent incubates, this keeps more surface of each egg covered and helps the eggs stay warmer.

Black-bellied Plovers have a migration which can be thousands of miles long, but they often return to build their nest within 300 feet of last year's nest.

Short-billed Dowitcher males are believed to roll their eggs to a new nest if threatened.

ADDITIONAL ACTIVITIES: *NESTING AND BREEDING*

1. **Imagine and Act. 6-9.** Assign a different shorebird species to each student. Have the students research to find out how the species' mate-attraction or courtship display is described. This information is readily available in many shorebird texts and guides. Because written information is far more commonly available than pictures or films, at least for a wide range of species, this provides a good exercise in careful reading, interpretation, and imagination. Acting out behaviors also will probably prove more instructive and memorable than merely viewing pictures.

Have the students sit in a circle, clearing floor space in the center to allow for any running or hopping. Ask the students to imagine what their birds might look and sound like when engaging in this display. Go around the room and have each student read out loud a description of the behavior, and then act it out for the class. Encourage strenuous participation by applause, inviting a class of younger students in for viewing, or requests for others who want to try their own interpretation of someone's description.

2. **Bird Posters. 4-12.** By concentrating on the study of a single species and illustrating its behavior in the context of its environment, students learn about the fascinating, basic biology of breeding shorebirds. Have each student design a poster of a different species of Arctic-nesting shorebird.

Each poster should include:

- Common and scientific name.
- Aerial view of nest, showing number of eggs commonly laid by species. (How should the eggs be arranged to minimize heat loss?)
- Picture of mating or courtship ritual: A labelled picture showing the student's interpretation of a part of the bird's mating ritual. In other words, if information on the species says that the male stretches his neck, spreads his tail, makes a buzzing sound, and crouches, do your best to *imagine* what this looks like and then draw it, labelling the parts and sounds as an additional visual aid. Stress depiction of the actions (i.e., cartoon-form is o.k. for this particular picture) rather than detailed morphology of the species. Read aloud a ritual description and draw your own interpretive cartoon on the board as an example.

  Note: You may wish to have students do this imagination exercise first, with each student acting out for the class his/her interpretation of what the bird does.
- Picture of bird on its nest, showing the surrounding habitat. Label at least four elements of the habitat (e.g., rocks, grass, insects, other birds, predators) so that it can be recognized as muskeg, tundra, beach, etc.. Put a caption under the picture as follows: " __________ (species name) nesting in __________ habitat.
- Have advanced students label birds as male or female, according to which sex of that species would be on nest or displaying as shown.

3. **Match the Cards. 4-12.** Add cards to the "Match The Habitat Cards" activity (see *Habitat* chapter, page 53) using nesting and breeding terms from the Key Words list at the end of this chapter. As pointed out elsewhere, the concepts of adaptations, habitat, breeding, and migration are all related and indeed entwined.

4. **Videos/Tape Recordings. K-12.** The visual displays of many breeding shorebirds, while amazing and even spectacular, are not universally readily viewed by students because of their confinement to the high Arctic summers. Sounds are often particular attention getters for children, and the study of sounds facilitates learning in many students who are not primarily visual learners. Many vocalizations can be heard while observing migrating or wintering shorebirds, but the different calls that are used on the breeding grounds are not available to many students. If this is the case for your school or season, try to obtain video or tape recordings of shorebird breeding displays and vocalizations.

If a tape specifically on breeding shorebirds is not available, try general ones on birds or vertebrate breeding activities. Because of the unusual nature of shorebird breeding displays, many general bird videos include shorebird footage. Also, many general (made particularly for Alaska or your state are best) "bird call" cassette/CDs include shorebirds.

Discussion questions should include: "Based on what you've read about the sounds this bird makes, do you think that this recording was made on migration or on the breeding grounds?" "Based on where it was made (what state the tape is for), do you think it was made on migration or on breeding grounds?" "Do you think the written description was accurate?", and "Why do you think shorebird males don't sing elaborate songs like songbirds?" (Songbirds are advertising their territory and looking for mates in habitat with generally much denser, more concealing vegetation than shorebirds.)

For help obtaining tapes, contact your local state or federal fish and wildlife agencies.

5. **Make your own Videos/Tape Recordings. K-12.** As a cooperative project, have the class make its own Shorebird Behavior Video or tape-recorded Shorebird Call Guide. Each student, or pair of students, is responsible for one species. Listen to a small portion (three or four birds, not necessarily shorebirds) of a bird song/call identification tape first to get an idea of how to orally "label" each call, so that the tape produced can be used as an actual identification guide. Tape record the students vocalizing their best interpretation of their shorebird's calls. After students have produced an audio tape, have them listen to a professionally-produced tape of the actual shorebirds, and discuss differences. Alternatively, videotape the students doing their interpretation of the mate-attraction, courtship, territorial, nest-protection, and/or other displays.

Older students can operate the video camera, direct, and provide taped introductions and other material. Students of all ages can make boldly-lettered signs of species names to video between segments of displays. Because of the extensive scope of this project, it is best performed in steps (e.g., researching what the bird sounds or looks like; imagining what it sounds or looks like based on written descriptions; practicing for an audience of younger students or as part of one of the other activities in this Nesting and Breeding chapter; drawing signs or producing props or costumes for the videotape) over several days, or incorporated over time with other shorebird activities.

Younger students can act out various suggested shorebird behaviors like those listed in "Behave Yourself!" on page 108.

126

6. **Displays by an Expert. K-12.** Perhaps there is a local bird enthusiast in town who is adept at shorebird calls or displays and would come in to demonstrate a few for your class. Before his/her visit, have students brainstorm questions about shorebirds to ask after the demonstration. Students can also demonstrate their own bird calls or displays (see above activities), asking the expert to guess who they are and receiving pointers.

Research Ideas

7. **Observations. K-12.** While observing shorebirds in the field, ask students to observe and consider *behavior*. Possible questions for discussion: Why (do you think...) is that shorebird standing on one leg? Where is that bird's head? Why does that bird have it's head down? Does the bird at the head of the flock always stay at the head? Does the wind seem to affect the birds behavior? Why isn't that bird eating?

Have students take notes (older students) on behavior while watching for and discussing (all students) the following:
a) Eating, sleeping, and grooming behavior. How is the bird eating? How long does it sleep?
b) Any behavior that does not seem directly related to personal eating, sleeping or grooming
c) Also watch for any *repetitions* of actions; a possible provocation or impetus for an action; and/or any vocalizations involved.

8. **Library Race. K-9.** As a warmup or fill-in library activity which promotes critical evaluation of library resources, have students take part in a "library race". Ask them to locate, within a time limit (five or ten minutes), a picture of a shorebird in a book or magazine. The book must be something other than a shorebird book or bird guide (pull and separate those books first). They will have to think about what books might have pictures of shorebirds (e.g., books on Alaska or the shore, children's story books, encyclopedias, National Geographic). Students can work in pairs, but each pair must find a different book. Extra points for a shorebird on a nest or with chicks. Extra points if they can explain what habitat the bird is pictured in.

9. **Breeding Habitat Threats. 6-12.** Have students research to find out what threats exist, if any, to Arctic-nesting shorebird breeding habitat. Because of the relative remoteness and enduring wilderness quality of the ***High Arctic*** (extreme upper latitudes of the Arctic), loss of such breeding habitat is generally not considered to be among the current major threats to shorebird survival. The objectives of this research activity include learning about the High Arctic and human resource use there; and practicing obtaining, using, relating, comparing, and contrasting a variety of sources from private enterprise, government agency, and local villages. This may also be incorporated in a larger resource project involving general threats to *shorebirds* or to all of the *habitats* shorebirds depend on in a year (in a class discussion compare and contrast these two overlapping threat categories).

Have the class brainstorm about where they might locate information, and discuss the importance of contacting multiple sources. If a number of students conduct this research individually and present their findings to the class, the significance of multiple sources will become obvious. Alternatively, the entire class can research together, with each student responsible for obtaining/contacting a different source and writing up his/her findings. Class research can be compiled, as it comes in over the days or weeks, on one large poster of butcher block paper. Have each student be responsible for writing one-two paragraphs, recording their source, and drawing a map, diagram, or picture giving information related to their findings. Alternatives to ensure that each student learns from the entire, completed poster include having them: present their findings to the class; privately write their own quiz question on their piece and turn in to be compiled into a general class quiz; or write a page showing the relationship between three sets of findings.

Besides time, such research will require one or more of the following: an interlibrary loan service, access to the library of a public lands or wildlife agency such as U.S. Fish and Wildlife Service. letters written requesting information from both Arctic villages and oil companies.

10. **Chick Development. 9-12.** Students can choose a shorebird and research chick development (i.e., how many eggs laid, how many days old are chicks when fledged, what do chicks look like, what are threats to chicks, how old are birds when they first breed?). Advanced students can choose two species and compare and contrast this information.

11. **Egging and Subsistence. 9-12.** Older students can research the practice of shorebird and seabird ***"egging"*** (the harvesting of eggs for subsistence purposes) in the Arctic. Students in subsistence-based rural areas can interview elders about species and time of year. Careful supervision and maturity are prerequisites for researching this sometimes sensitive issue.

12. **Advanced Information Reading. 10-12.** More detailed information on shorebird nesting and breeding is available in Appendix C. This may be useful for both teachers and students. A worksheet for use as a reading guide and a list of "Additional Activities" follow the reading.

KEY WORDS: *NESTING AND BREEDING*

- breeding grounds
- breeding season
- brood
- clutch
- copulate
- courtship
- egging
- fledge
- fledgling
- gesture
- home range
- incubate
- jaeger
- lek
- lekking
- mate
- mating system
- monogamy
- pair bond
- polyandry
- polygamy
- predator
- promiscuity
- ritual
- scientific method
- scrape
- site-faithful
- territory
- territoriality
- variable

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MIGRATION

CONCEPTS:

- During each year of their life, most shorebirds migrate between habitats located in different geographic areas.
- Arctic-nesting shorebirds undertake some of the longest migrations of any vertebrates.
- Migratory shorebirds depend on at least three habitats: breeding, nonbreeding, and migratory stop-over sites.
- Some shorebirds concentrate in great numbers at their stop-over sites.
- Because of this concentration, shorebird populations are extremely vulnerable to threats along their migratory routes.
- Most important migratory stop-overs are nutrient-rich *estuaries*, which also provide resources desirable to humans and are vulnerable to alteration, pollution, and destruction.
- Most shorebirds migrate between northern breeding areas and southern wintering areas to take advantage of seasonal food resources.

THE MAGNIFICENT MIGRANT

Migration is the regular movement of animals between two different geographic locations. In most cases this movement is ***seasonal*** and involves moving to and from breeding grounds and then back again the following year. Most migratory vertebrates breed only within a particular time of the year. If you hunt sheep or moose, go whalewatching, or enjoy watching birds, you are probably familiar with this phenomenon.

> ***Note:*** There are other, nonseasonal types of migrations in the Animal Kingdom. For example, some small aquatic invertebrates with short life spans travel regularly up and down in the water because of changing food availability and predation threats. This is called ***diurnal***, rather than seasonal, migration because the movement takes place daily in response to light, usually at dawn and dusk.

THE MYSTERY OF MIGRATION

Migration is a mysterious topic. We know that shorebirds are physically designed for long, rapid flight with their long, pointed wings, but what about how they find their way? How do birds, fish, mammals, and insects travel the immense distances they do with such exactness? How do first-year shorebirds, travelling without their parents, find their way south for the first time? Some migratory animals travel at night, some during the day, some in the skies, and others deep within the sea. Yet, unerringly, they locate habitats necessary for the continuation of their species. Scientists have proposed that migrants use the stars, the sun, and even the Earth's magnetic field for guidance. Some animals seem to use smell, as the salmon apparently do to guide them from the vast ocean to the particular stream of their birth. Most probably, migrating species use a combination of means (e.g., senses, celestial clues and landmarks, instinct) to guide this most important journey.

MIGRATING SHOREBIRDS CONCENTRATE IN GREAT NUMBERS

There are a variety of remarkable migrating birds, including songbirds, waterfowl, raptors, and of course shorebirds. Arctic-nesting shorebirds are famous for their spectacular migrations, not only because of the distances they fly and their extreme-north summer destination, but also because of the huge numbers that concentrate at ***stop-over sites*** during spring migration. A tight swarm of hundreds of thousands of feeding shorebirds is truly a thrilling spectacle. Over one million shorebirds, mostly Western Sandpipers and Dunlins, have been recorded in a single spring day on Alaska's Copper River Delta. In fact, practically the entire North American population of Western Sandpipers stops there to rest and feed.

One reason why migrating shorebirds appear in such numbers is that most Arctic-nesting species tend to use the same relatively few stop-over sites to rest and refuel during spring migration. In other words, unlike songbirds which migrate along broad corridors, shorebirds coming from many different wintering locations are ***"bottle-necked"*** at just a few vital wetland sites. The Copper River Delta, for instance, is thought to be the most important (i.e., heavily used and depended upon) stop-over site for all Western Sandpipers along the Pacific flyway. Shorebirds stop at these sites because of the superabundance of crustaceans, molluscs, worms, and other energy-rich foods there that are needed to fuel these incredibly long flights (see page 175 for peak dates along the Pacific Flyway).

Shorebirds are in a big hurry when they are migrating in the spring towards their breeding grounds. An entire population needs to arrive within a few days of each other so that they can successfully find mates. We have already seen how shorebirds, with their long, pointy wings, are physically adapted for rapid flight. Some fly up to 80 kilometers per hour during migration. (How many miles per hour is that?)

The Arctic summers are also very short. Birds have only about two months in which to find a mate, establish a territory, lay eggs, and raise their family to fledging stage! Because of this universal need to head north as soon as the season permits, large numbers of shorebirds migrate at the same time. Individuals may rest for only one to three days, with almost the entire population of migrants moving through a stop-over within a week or two.

WHERE DO SHOREBIRDS MIGRATE?

Migratory routes of birds are referred to as ***flyways***. In North America, birds tend to migrate along north-south flyways. One of the major routes used by Arctic-nesting shorebirds is the Pacific Flyway. It follows the eastern Pacific coastline (western North and South America). Other shorebird flyways extend across the ocean from Pacific islands like Hawaii, and up through the interior of North America. Locate other flyways on the "Shorebird Migration" map. The flyways are not specific, narrow "highways", but general routes which most of the migrants tend to fly along before and after *bottle-necking* (concentrating) into well-established resting stop-overs.

Most migrating birds require the presence of wetlands in their breeding habitat and on their wintering grounds. Since these two regions are often thousands of miles apart, these birds also need wetlands to provide them with food and rest in between. This means, as we have previously discussed, that ***migrating birds like shorebirds depend on at least three habitats each year***.

They also tend to be very ***site-faithful*** and need to use the same sites each year. Wetlands like ***estuaries***, rich habitats where a source of freshwater meets the ocean, provide some of the most important shorebird habitat in the world.

The same bird may use three very different wetland types for the purposes of breeding, resting during migration, and living the majority of their year ("wintering"). For instance, it may nest on upland tundra, migrate inland with stops near ponds, and winter on mudflats. Many shorebird species which nest on tundra depend on coastal beaches and mudflats the rest of the year.

It has been said that "birds know no borders." In other words, migrating birds depend on sharing global resources. Many Arctic-nesting species migrate to Central and South America to spend their winters. Others winter in the contiguous 48 states or Mexico; still others in Hawaii or Pacific islands south of the equator. The members of most species tend to be relatively concentrated on the breeding grounds compared to where they occur in winter. Sanderlings are one of the most extreme examples of this. The species is confined to the high (i.e. upper/far north latitudes) Arctic during the breeding season, but may otherwise be found along the east and west coastlines of North America, South America, and Africa, as well as much of the outer coast of Europe, southern Asia, Australia, and innumerable islands.

Many high-Arctic breeders, particularly those breeding near the coast, are ***circumpolar*** in distribution. This means that species like the Black-bellied Plover or Red Phalarope which breed in north- or westcoastal Alaska, are also likely to breed in northern Asia (the Palearctic). Sanderlings and Dunlins breed in coastal Greenland, Canada, and Asia. Examine your globe and note that these coastal areas are really relatively close together and contain similar tundra habitat.

(For information on migratory routes and breeding habitat of shorebird species, see Appendix E.)

WHEN DO SHOREBIRDS MIGRATE?

Shorebirds migrate with the ***seasons***; they migrate twice a year. In the spring, as snow recedes and as soon as weather permits, they head north so that they may breed during the summer. In the late summer they migrate south and spend up to ten months of the year on their nonbreeding grounds.

Shorebirds on spring migration show up in the Copper River Delta of Alaska in the last week of April and first week of May, some moving on within days to the breeding grounds of the Arctic.

Breeding on the tundra begins roughly in late May, depending on snow conditions. Sanderlings, which breed in extreme upper latitudes, usually lay their eggs in mid-June.

If you are lucky enough to have a spring migration stop-over site near you, ask yourself what it's like in the fall. Migrating birds use these sites, but do not concentrate in nearly the same numbers as they do in the spring, and their appearance is more spread out over time. They use other wetlands as refueling stops as well. This is because they don't have the same *constraints* in the fall that require them to quickly get up to the Arctic breeding grounds together in the spring. In the fall, the only constraint is to get south by winter, and the pace is relatively leisurely.

In the spring most migrants are hopeful breeders. There are several more categories of birds in the late summer and fall. Post-breeding migrants can be failed breeders, successful parents, or young. Failed breeders have no chicks to raise and so can head south early. Migration for successful breeders begins as early as mid-July. Shorebirds do not migrate in family groups like geese, swans, and cranes. Adults leave the breeding grounds first, with juvenile birds following in an average of two weeks. Chicks must grow strong and fatten up enough before the migration.

Notes: In any discussion of globally-occurring animals like shorebirds, "spring" and "fall" are relative terms. We often use the terms "summer" and "breeding" to mean the same season, because the Arctic is experiencing summer when shorebirds are there to breed. Also we tend to use the terms "nonbreeding" and "winter" interchangeably. Remember, though, that although we in the Northern Hemisphere may be experiencing winter from November to March, the Southern Hemisphere is experiencing summer at that time. We might refer to those shorebirds which have migrated south of the equator for their "nonbreeding" months as "wintering" in, say, South America, but they really get two summers, don't they!? (When you're brushing up on your geography, note that the equator not only divides two physical halves of the globe, but, because of the tilt of the Earth's axis, it generally divides the seasons too.)

Note also that in North America our seasons tend to be "spring", "summer", "winter", and "fall". In some parts of the Earth, particularly in areas close to the equator, seasons may instead be more aptly divided into "rainy", "dry", or "monsoon". Better seasonal terms for shorebirds might be: breeding, post-breeding migration, nonbreeding, pre-breeding migration.

WHY DO SHOREBIRDS MIGRATE?

Although migration is still not perfectly understood by scientists, it is a ***strategy*** that has evolved in species over time, probably as conditions in the Earth's geography and climate changed. One theory is that as the last Ice Age ended and northern areas began to experience warmer weather, the short summers favored animals with short life spans (and therefore rapid breeding cycles), like insects. These insects were then available as food in an area with relatively less competion or predation pressure. Some birds moved north to take advantage of this food, which of course is still only available in the summer.

We do know that migrant shorebirds today take advantage of the abundant source of invertebrate food items (e.g., cranefly and midge larvae, pupae, and adults) in the Arctic. Although the constraints aren't completely understood, migration is a strategy that allows birds to take advantage of productive feeding grounds or areas with less competition.

THREATS TO MIGRANT SHOREBIRDS

What threats affect shorebirds that migrate through the United States to the Arctic each year, even though their total population currently numbers more than 20 million? First, remember that this includes *many species* of shorebirds, all playing their own unique and critical role in the global environment. Most migrant shorebird populations are dependent for vital food and rest on the ritualized use, year after year, of the same estuaries. The primary threat to the survival of migratory birds are the disappearance and degradation of these wetlands. Without wetlands, dozens of species of birds face loss of habitat necessary for survival.

Loss of Wetland Habitat

Shorebirds are especially threatened by the loss of wetlands. That is because they are genetically programmed to stop at only a few particular places along the flyway. If one of these stop-over locations is lost to development, shorebirds do not know that they should try to stop a mile or two up the coast (even if such an alternative existed). Instead, they instinctively try to fly on to the next stop, perhaps hundreds of miles away, without resting or feeding first. Many do not survive.

Even some of the most abundant species concentrate much of their entire population at just a few critical stop-over sites during migration. Five sites (including Alaska's Copper River Delta and Washington's Gray's Harbor) in North America support more than a million shorebirds during each spring migration.

Agriculture, ***urban expansion*** (development of more structures and roads which spreads from existing towns), and industry are reducing the availability of natural wetlands. Wetland habitats, usually found in low, fertile plains along water courses, were historically farmed and settled. Wetlands are drained to "reclaim" (perhaps the term should be changed to "claim") the land for development or crops. Water is extracted from estuaries for irrigation and other uses. Modern agriculture is based on ***monoculture***, or the use of a piece of land for a single type of crop. Such a crop, be it rice, wheat, corn, or Douglas Fir trees, does not provide habitat for many species of shorebirds or other animals, and natural species diversity is severely affected.

Hunting Pressure in the Past, and in other parts of the World

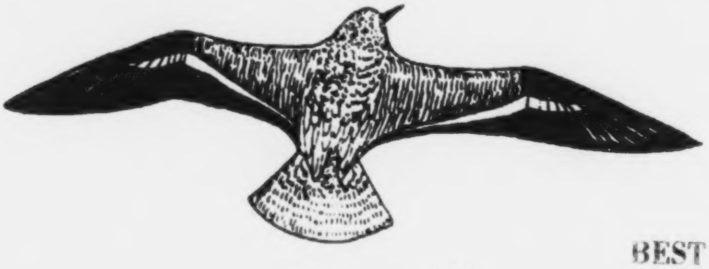
The migration routes, or flyways, of shorebirds are well known. Large, predictable flocks are very vulnerable to hunting. Before regulations, ***market hunters*** of the 19th Century took advantage of the fact that vast numbers of shorebirds would often concentrate at set points along these routes, and these hunters greatly reduced the flocks. Arctic-breeding Red Knots, which migrate northward across the United States in massive flocks, were severely affected by shooting during the 1800s. The critically endangered Eskimo Curlew was once called the "doughbird", and was hunted for food and sport during migration. This slaughter and subsequent habitat loss have brought this bird to the verge of extinction, and fewer than 100 are probably alive today. In many countries around the world, migrating shorebirds still face hunting pressure.

Disturbance

Besides loss of wetland habitat and hunting pressure, migrant shorebirds are threatened by disturbance at their stop-over sites. As discussed above, shorebirds exhibit site fidelity to their traditional stop-over sites and if flushed off of them by such disturbances as off-road vehicles or dogs, will have to continue migrating without vital food and rest.

Pollution

Pollution, through the use of pesticides and the use of lead shot rather than steel shot during hunting, takes its toll. There is evidence to suggest that acid rain and acid snow may be affecting insect populations which in turn affect fish that depend on the insects for food. This, in turn, affects the birds that depend on the fish for food. Predators, weather, disease, and fire influence both the animals and their habitat.



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Solutions

All living things share this planet and, in the long run, habitat destruction threatens us all. Many federal, state, indigenous, and private groups recognize the importance of wetlands to wildlife. Millions of acres of wetlands have been purchased and protected to actively preserve and restore habitat for local and migratory wildlife. There are international treaties and national laws affecting migratory species. In the United States, the U.S. Fish and Wildlife Service has principle legal responsibility for managing migratory wildlife at the federal level. State wildlife agencies share some responsibilities with the U.S. Fish and Wildlife Service in protecting migratory animals.

BIRD BANDING

Scientists can attach radio or satellite transmitters to migratory animals to see where they go. There are drawbacks to this method though, including the expense, especially if a large *sample size* is needed. Also, while transmitters are being made smaller and smaller, they can still be difficult to use with small animals, and do not give all the detailed information that one can obtain by actually viewing the bird. The main technique used by scientists to follow the movements of birds is *banding*.

WHAT IS BIRD BANDING?

Bird banding is a method of capturing, marking, and releasing wild birds so that they may be studied in their natural habitats and performing their normal behaviors. Biologists have been marking birds for study for more than 100 years. The first record of anyone marking a bird for study was that of John James Audubon, who captured an Eastern Phoebe in the 1850's and wrapped a small piece of silver wire around its leg, noting that the same individual bird returned to the same place the following year.

Today, bird banding involves attaching a tiny aluminum bracelet to a bird's leg, just above either the toes or the knee. This is a loose-fitting band that does not harm the bird or restrict its movements. Many of the details of birds' lives are known only through the observation and banding efforts of scientists around the world.

Some research studies also require birds to be ***color-banded***: additional loose-fitting, colored plastic bracelets are fixed around the bird's leg. One color band or several different colors in a particular combination of order on the bird's legs may be used. Either way, the point is to enable a researcher to identify a marked bird from a distance, without actually having to recapture it.

Because learning to handle birds properly (their anatomy is different from yours!) requires special training, and because valuable information can be wasted or lost if birds are not banded properly, a special permit from the U.S. Fish and Wildlife Service is required for all bird-banding in the United States.

WHY BAND BIRDS?

To discover which kinds of birds live in a particular area or habitat, we could walk the area throughout the year and watch for different species. With the aid of a good field guide and plenty of practice, we should be able to identify all of the species that come to an area.

What about questions dealing with age, ***survivorship*** (e.g., how many chicks survive to fledge?, how many chicks survive to breed?), ***mortality*** (e.g., how many die at specific ages or due to specific causes?), or behavior? These require us to not only be able to see and identify species, but to tell individuals apart.

In other words, you see a Long-billed Dowitcher on your local beach, and you know dowitchers are found in Mexico. Does the dowitcher from your beach go to Mexico, or somewhere else? Is the dowitcher you see this year the same one you saw last year? If what you see the dowitcher feeding on is killed off by some disaster, will the same dowitcher find another food source or feeding habitat? How long do dowitchers live? Does it find the same mate next year, or mate with more than one individual in a year? Do male and female dowitchers feed in different tidal zones?

Unfortunately, most Long-billed Dowitchers look alike, at least to humans. How do we know which bird is which? Banding helps provide answers.

WHAT DO WE LEARN FROM BANDING?

Some birds live in your state or near your village or town only during the summer, when they are breeding. Others only pass through on migration. Still others live nearby year-round. These latter species are known as permanent residents. How many resident birds can you think of in your area? These birds use the habitat in different ways, or for different things. Learning about their habitat-use patterns is only one of the types of data available through banding.

It is important to estimate the number of birds in order to monitor ***population trends*** (increases and declines over time). To do this, we must be able to compare population sizes from different years. We can go out and count them every year, but how do we know that one group of birds hasn't been killed off by a storm during migration and replaced by a different group? If a decline is noted, how do we know if birds are experiencing a threat on their wintering grounds, migratory route, or nesting habitat? We often want to know that we are following the population trends of the same group of birds. If populations decline at a threatening rate, we can activate management strategies to help them.

Some birds that nest in the Arctic winter as far south as South America. Do these birds winter in a very specific area? Are they threatened with loss of habitat on their wintering grounds? By marking individuals and seeing where other biologists catch them again, we can learn about their travels. This knowledge is dependent upon catching the same bird twice. Most birds that are banded are never recaptured. The number of birds that are banded is therefore often very high, and researchers in the United States and other countries share their information to increase their chances of collecting data.

Many questions require us to tell individuals or populations apart from other members of the same species. Other questions that banding can help answer are ones dealing with migration patterns or destinations.

METHODS OF CAPTURE

One typical method used by researchers to catch birds for banding is ***mist-netting***. A fine net is stretched across an area where birds are likely to fly. If the habitat is open, as is often the case with shorebirds, the net may be used at night. Birds are caught when they fly into the net. A researcher quickly untangles the bird and bands it, collecting data on the species, age, and sex. Each band is coded ahead of time with a unique identification number. The bird is then released.

Another method for capturing shorebirds for banding is to band chicks which cannot fly. Bird legs are often close to adult-size even this early, and so leg-banding is easily done without harming the bird. If we mark young birds in the year they hatch and record their annual return, we can see how long they live, and if they are being replaced by a sufficient number of young.

SHARING INFORMATION IS IMPORTANT

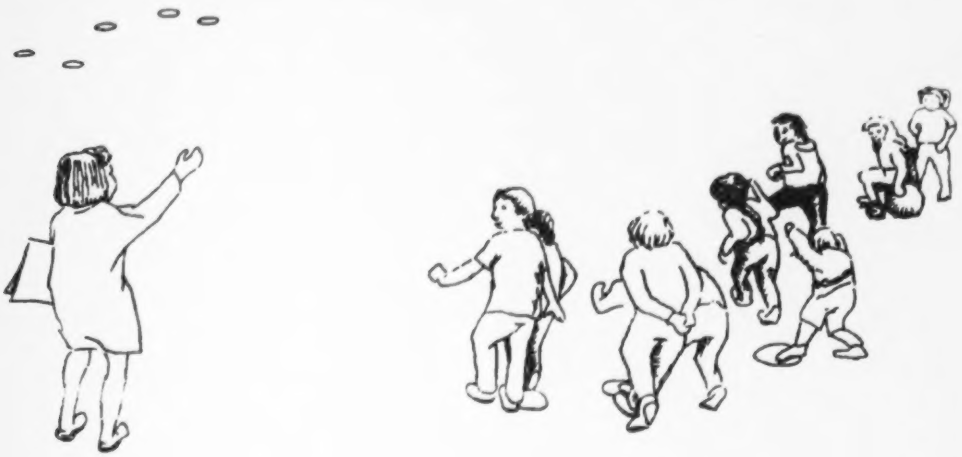
Many birds that have been banded disappear and die without the researchers knowing where, when, or why this happened. If you ever find a dead bird with a band on its leg, you should notify your local state wildlife agency or the U.S. Fish and Wildlife Bird Banding Lab. Record the entire number on the band, the date you found the bird, the species (if you know it), and the exact location. Send this information (along with the band, if possible) to:

Chief, Bird Banding Laboratory
Office of Migratory Bird Management
U. S. Fish and Wildlife Service
Laurel, MD 20810

or call: 1-800-327-2263

There is a very high percentage of natural losses, especially among young birds. Any additional destructive threat may have a significant impact on bird populations. We can help birds best if we understand where they live, what they need, and where they travel. Banding is one technique that provides us with the essential information we need to manage habitat for bird conservation.

MIGRATION HEADACHE



Grade level: 2 - 8

Objectives: By role-playing migrating shorebirds in an active game of traveling between nesting and wintering habitats, students dynamically experience some of the important factors which affect the survival of migratory shorebird populations. Be able to list *limiting factors* (environmental components or occurrences which limit the population size or potential for population growth or survival) affecting populations of migrating shorebirds. Predict the effects of habitat loss and degradation on populations of shorebirds. Make inferences about the importance of suitable habitat for migrating shorebirds. Practice comparison, observation, interpretation, inference, and physical coordination skills.

Duration: One 40-minute class period

Materials: 2 paper plates per student (clearly mark the plates, perhaps with a large X on one side, to differentiate top from bottom)
"Factors Affecting Survival" cards, made according to the directions below

Teacher Preparation:

1. Prepare a set of cards using large (9" by 12" or larger) pieces of construction paper. Each card will list one of the factors (see the table on the next page) affecting survival on one side, and the number of plates lost or gained as a result of this factor on the other side.
2. Select an area about 20 meters (about 70 feet) in length, either indoors or out, where the students can race back and forth.
3. Younger students may be confused by interchangeable use of the terms "breeding" for "nesting" and "nonbreeding" for "wintering", so choose one set and be consistent.

Factors Affecting Survival

Factors REDUCING Survival	# of plates lost*	Factors FAVORING Survival	# of plates gained*
urban expansion	5	preservation of wetlands	4
wetland drainage	5	dynamic balance with predators	4
conversion of wetlands to farmland	4	restoration of habitat	3
pollution and contamination of water (e.g., oil or chemical spill)	3	education about wetlands and habitat	3
drought	3	normal rainfall (i.e., neither drought nor flood)	2
conversion of natural waterways to canals	2	education about hunting	1
lead shot in food supply	2		
illegal hunting	1		

* *Number of plates lost/gained:* these numbers are only suggestions, and not necessarily in accurate or direct proportion to the size of the threat, percent change in survival, etc., which will *vary between particular places or incidents*. You may choose to alter the number indicated, particularly *in relation to class size*.

Procedure:

1. Place one half of the paper plates at each end of the field, spreading them across the ends as in the diagram on the following page.

2. Explain to the students that they are shorebirds and will migrate between these two areas at the teacher's signal. Tell them that the paper plates represent wetlands. Each one is suitable habitat for only three shorebirds (students).

Rules for shorebirds: At the end of each migration, the students will have to have one foot on a paper plate in order to be allowed to continue. If they cannot get a foot on a plate, they have not found suitable habitat, they "die", and have to move, at least temporarily, to the sidelines and watch.

3. Explain to the students that many factors limit the survival of populations of migrating shorebirds. Some involve changes in the nonbreeding ("wintering") and breeding ("nesting") habitats. There will be times of abundant food, water, shelter, and space suitable to meet the habitat requirements of the birds. There will be other times when the necessary habitat is stressed, with many factors limiting the potential for survival. The area of available habitat is also sometimes reduced through destruction.

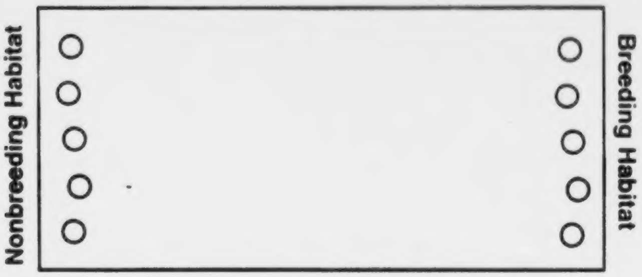


Diagram of Playing Field

4. Begin the activity with all the students at the nonbreeding habitat.

5. Announce the start of the first migration. Have the students migrate in slow motion until they become familiar with the process. Then they can speed up. On the first try, all the birds should successfully migrate to the nesting habitat (because we have started with one plate per student per habitat). Explain that there has been no loss in available nesting habitat. Thus, a successful nesting season is at hand.

6. Before the students migrate south toward the nonbreeding habitat, turn over one plate from the wintering region. Explain that a large wetland area has been drained and used for agricultural purposes. Repeat the instruction to migrate and send the birds to the wintering habitat. Have the three students that will be displaced move to the sideline. Tell the students that these three have died as a result of loss of habitat. Remind any "dead birds" that they will have a chance to get back into the activity. They can come back as surviving hatchlings when favorable conditions prevail and there is habitat available in the nesting ground.

7. Before the next migration to the nesting ("breeding") region, turn over four plates in the breeding habitat. This represents a catastrophic loss. Tell the students that this is the result of a period of unusually heavy rain during nesting which flooded many of the nests. Instruct the students to migrate. This results in a large number of students waitings on the sidelines to re-enter the nesting habitat.

8. Before each succeeding migration, choose a "Factors Affecting Survival" card, explaining the factor and the effect before changing the number of plates. Each time, give the students examples of changes in habitat conditions that could have taken place making it possible for them to survive. The teacher will need to choose with some discretion to ensure too many plates aren't added. Before many cycles are repeated, provide the "shorebirds" an opportunity for re-entry. Two students can be made permanent monitors to turn the paper plates over as you instruct them.

Some limiting factors are a natural and dynamic part of any environment. This is true of factors favoring survival as well. Be sure to have one or more "disaster" years to illustrate catastrophic loss of large areas of available habitat.

9. Repeat the process for eight or ten migration cycles to illustrate changes in habitat conditions with resulting effects on the birds. Remember that, overall, the availability of suitable habitats for shorebirds are diminishing. The activity should end with fewer areas of available habitat than can accommodate all the birds. The greatest long-term threats to the survival of populations of shorebirds are the loss and degradation of habitat.

10. Have the class discuss the activity. **Possible post-activity discussion topics:**

- Although the shorebirds in this game are "migrating," this activity focuses on factors not on the stop-over sites but on the nesting and wintering habitats. Discuss with students which of these factors could affect migratory stop-overs as well.

- Have students summarize what they have learned about some of the factors that affect the success of shorebird migration. Make two lists, discussing human-caused factors and environmental factors. Compare similarities and differences between these limiting factors. Highlight those which the students identify as posing the most significant long-term threat to the survival of shorebirds. Is anyone aware of threats to local shorebird habitat? Seek additional information through research.

- Identify the apparent causes of the birds' population decline from year to year. Try to imagine the major factors contributing to habitat loss and degradation. Make predictions about the effects of these factors and how long they will last. Distinguish between *catastrophic* effects and gradual changes. Ask the students to support their hypotheses with evidence; seek additional information through research if necessary.

- What kinds of things can and should be done to protect and restore habitats for migrating bird populations? Discuss potential trade-offs (for humans and other organisms including shorebirds) related to any recommendations.

Extensions:

Pre-Activities:

1. Have students prepare the "Factors Affecting Survival" cards. Each student prepares one card by writing the factor in large letters and then illustrating the factor with pictures (e.g., a border, symbols, or scene format).

2. Have students practice compass use, familiarize themselves with the logistics of their own immediate environment, and reinforce what they are learning about migration routes of Arctic-nesting shorebirds by asking them to orient the playing field in a north-south direction. Ask them which end of the playing field will now be the "nonbreeding habitat" (south) and which end the "nesting or breeding habitat" (north). Alternatively, invite a local elder or outdoorsperson to teach the class about indigenous people's and other methods of direction-finding.

Research Ideas:

3. Find out more about the national laws and international treaties protecting migratory species. What is their history? Are they effective? Are there problems enforcing them? What migrating species, if any, are unprotected by such laws?

Adapted from *Project WILD Aquatic Education Activity Guide*: ©1987, 1992 Council for Environmental Education. Adapted with permission from ***Project WILD Aquatic Education Activity Guide***. The complete Activity Guide can be obtained by attending a Project WILD workshop. For more information, contact the Alaska Project WILD Office at 907-267-2168.

- Activity -

MIGRATION MATH MADNESS

Grade level: 4 - 9

Objectives: Learn about the speeds and distances that shorebirds fly by making calculations. Become familiar with the geography of the Pacific Flyway. Practice skills of map reading and usage, data recording, comparison, relating numbers to real events, and multiplication. Practice converting to the metric system.

Duration: One 30-minute class period

Materials:
20-cm pieces of string (1 per student or group)
Migration Math Maps and student readings (1 per student)
Marking pens or crayons

Procedure:

1. Have students read the page called "Migration Math Madness."

2. Cut one piece of string that is 20 cm long. Hold the end of the string at the end of one of the migratory paths drawn on the map. Lay the string along the path so that it follows it exactly. At the end of the path, mark the string with a crayon or marker.

3. This string is now marked at the same length as the line on the map. Remove the string from the map and compare it with the mileage scale to find out how many miles the bird traveled.

4. Convert the mileage into kilometers. Remember that 1 mile = 1.609 km. If you start with kilometers, 1 km = 0.621 miles.

5. Repeat steps 2 and 3 for the other paths shown on the map. Write your answers in the spaces below the map.

6. Calculate how long it would take these birds to reach their Alaskan nesting habitat at 40 miles per day, at 72 miles per day, or at 150 miles per day.

Extension:

Research the migration path of another shorebird that uses the Pacific Flyway to reach Arctic nesting habitat. Draw its migration path on this map and label it with the name of the species.

Adapted originally from Seasonal Wetlands and Salt Marsh Manual: An Educator's Guide.

- Student Reading -

MIGRATION MATH MADNESS

Migrating birds travel long distances between wintering and nesting areas. Most birds do not fly nonstop between these areas, although many are capable. Timing of the migration is related to seasonal temperature changes but is also triggered by changes in amount of daylight.

During the spring, most birds do not migrate north faster than the *35°F isotherm* moves. This ***isotherm*** is an imaginary, moving line that represents 35°F (air temperature) at any one specific time: the area north of this line is cooler than 35°F, and the area south of it is warmer than 35°F. What is significant about this temperature (what temperature is it close to?), and why might it be important to birds? Migrating north no faster than the isotherm moves ensures that when the birds reach their nesting areas, the water and ground will not be frozen. Look at a map of North America and see if you can guess when the 35°F isotherm passes through your state or province in the spring.

In the fall, temperatures affect the amount of available food. This is because insects and plants die off in cooler temperatures. Therefore, the birds keep moving south to where food is abundant enough to sustain them during their migration flight to the wintering areas.

The *Pacific Flyway* is one of the several general migration routes which Arctic-nesting shorebirds and other birds travel along between their nesting and winter seasons. Many of the shorebirds and waterfowl that we see, and many smaller birds which we might not even notice, are migrating along this flyway between their South or Central American wintering areas and their nesting areas in the Arctic regions of Alaska and Canada.

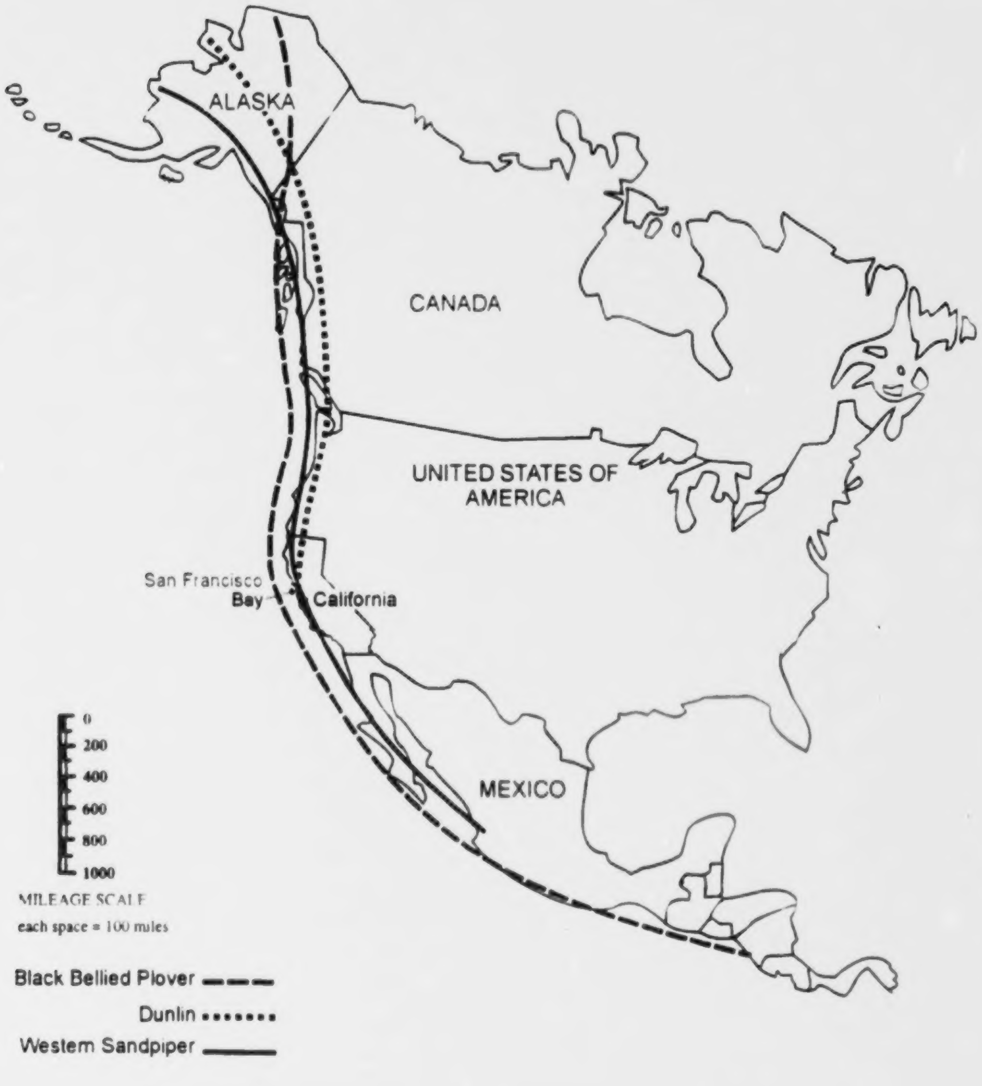
Wetlands are important to bird migration because they provide an area where the birds can feed and rest along the way. If a bird flies between Argentina and Alaska, it will cover between seven and eight thousand air miles. Without local wetland areas, many birds would not get enough food (energy) to sustain them throughout their migrations. Within the U.S., 28% of the total flyway wetlands are found in California, 15% in Oregon, and 10% in Washingon. (I wonder what percentage are found in southern Alaska? Brainstorm some ways that you could calculate this, and what background information you would need.)

Birds, like fish, can move in *three-dimensional* space. That means that besides moving *across* the Earth like we do they can also fly up and down. About 15% of the birds migrate at elevations below 10,000 feet. Many have also been observed at about 29,000 feet by jet airline pilots!

Birds fly faster the closer they get to their northern nesting grounds, where weather and the shortness of the summer become critical factors in getting nests built and young raised. Generally birds will fly for a few hours and then rest and feed for one to three days before migrating again. Birds migrating along the Central Flyway have been recorded flying 23 miles per day (mpd) up the Mississippi Valley, 40 mpd across southern Canada, 72 mpd to northern Canada, 116 mpd to Arctic Canada, and those going on to Alaska at 150 mpd.

MIGRATION MATH MADNESS: *MAP*

Shorebird Migration Along the Pacific Flyway


ALASKA
CANADA
UNITED STATES OF AMERICA
San Francisco Bay
California
MEXICO
0
200
400
600
800
1000
MILEAGE SCALE
each space = 100 miles
Black Bellied Plover
Dunlin
Western Sandpiper

Directions: Measure and record the number of miles travelled by each bird.

1 mile = ______________ kilometers.

1 kilometer = ________________ miles

Western Sandpiper:_______miles = _______km

Dunlin:_______miles = _______km

Bonus bird researched:___________ (species)

Black-Bellied Plover:______miles = ______km

_____miles = ____km

- Activity -

SHOREBIRD CIRCLE PUZZLE

Teacher Directions: Students can do this alone as a worksheet activity, or you can do this as a class activity, with the clues read aloud and the blanks filled in on the board.

Directions: The seven sentences at the bottom of the page are clues to the seven corresponding word blanks above. Fill in the blank spaces by figuring out the clues. When you have filled in all the blanks, the circled letters will spell the mystery word.

1. _ ○ _ _ _ _ _
2. _ _ ○ _ _ _ _
3. _ _ _ _ ○ _ _
4. _ ○ _ _ _ _
5. _ _ _ _ ○ _ _
6. _ ○ _ _ _ _ _ _   _ _ _ _ _ _
7. _ _ ○ _ _ _

Mystery word: ______________________________

1. A place that has waterlogged soils and is often covered with shallow water for at least part of the year.
2. A bird-bander who needed to capture shorebirds might use one of these.
3. Where an animal lives because it can find food and a place to rest or breed.
4. A type of wetland with cold winters, short growing seasons, and no trees.
5. How shorebirds get from their breeding grounds to their wintering grounds.
6. The time of their year when shorebirds are in the Arctic.
7. The route birds take during migrations: there are 4 or 5 major ones leading to the Arctic.

SHOREBIRD CIRCLE PUZZLE *Answer Key*

1. WⒺTLAND
2. MIⓈTNET
3. HABIⓉAT
4. TⓊNDRA
5. MIGRⒶTE
6. BⓇEEDING SEASON
7. FLⓎWAY

Mystery Word: Estuary

148

Adapted originally from *Wetlands & Wildlife.*

- Activity -

BIRD'S EYE VIEW

Grade level: 2-12

Objectives: Learn about migration; learn about environmental features and factors that are important to migrating shorebirds; investigate the interrelationships of living things. Practice skills of imagination, visualization, geography, use of scale, and drawing.

Duration: One 30-minute class period

Materials: Large newsprint
Large drawing paper (one sheet per student)
Pencils, colored pencils, markers, crayons, or paints

Procedure:

1. Ask students to remember what the world looked like below them when and if they've ever been in an airplane. Have they ever looked down on the tops of trees, clouds, a river, or the ocean shore? What was the purpose of their journey (did they have to go, or did they want to go?) Did they look forward with anticipation to the sight of the cabin, town, or even different type of climate and geography that they were travelling towards?

2. Ask them to imagine what the world looks like to a migrating shorebird in the spring or in the fall. How high does it fly? Brainstorm as a class about what sort of things on the earth below would be important to a shorebird. What kind of weather would it be experiencing? What would it see? (e.g., the shoreline; estuaries, river deltas, or other types of wetlands; receding ice or snow; other shorebirds flying with it or landing, feeding, or roosting below, perhaps in large flocks; tree tops; the height of the tide; storms; clouds; warm sunshine; people with binoculars; towns; cities; bare plowed field where last year there was a marsh).

3. Instruct students to draw or paint a picture of the world from the view of a migrating shorebird. Encourage them to accurately portray the habitat the bird might pass over and also use their imaginations so that their picture conveys the length of the journey, the altitude the bird is flying, and the feel of the air.

   Have them use the newsprint to practice drawing aerial views of objects and the appropriate sizes, etc.. When they are satisfied with their plans, they can draw a careful and complete picture on the drawing paper.

Adapted originally from Quinlan, Alaska Wildlife Week.

BIRD BEANS

Background:
In their rush to get to the summer breeding grounds as soon as the weather allows, many Arctic-nesting shorebirds migrate almost simultaneously. They also tend to share the same important stop-over wetlands along the migratory flyways. The flocks of shorebirds which can appear at these "rest stops" can number in the hundreds, thousands, hundreds of thousands, and even millions! Some flock sizes in the past, before 19th Century market-hunting wiped many birds out, were even larger.

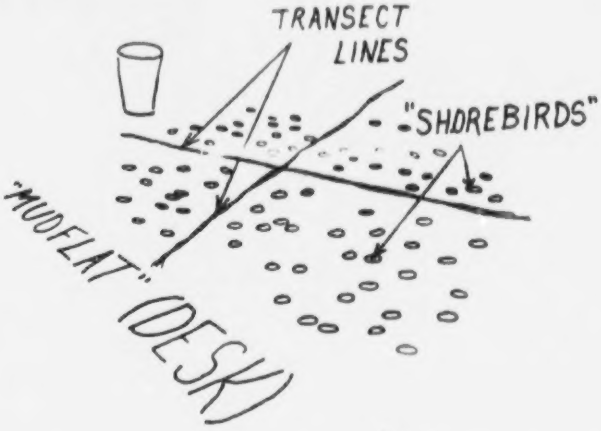
It is important to make an accurate *census* (count) of these shorebirds each year, or every several years, so that any changes in population can be noted, and hopefully understood. However, how can such a huge flock be counted and counted fast, before it flies away or splits up? This activity gets students thinking about methods that make counting numerous objects easier. Have students practice with "bird beans" before going on a field trip where they may see large flocks of migrating shorebirds.

Grade level: 4 - 10 (adaptable for grades 2 - 10)

Objectives: Learn about the importance of accurate, fast census-taking. Practice skills of critical thinking, comparison, cooperation, and linear and volume measurement. Practice math skills of counting high numbers, addition, and multiplication.

Duration: One 30- 40 minute class period

Materials:
"Sampling Populations" student reading
"Bird Beans" student worksheet
Dry beans (for Pinto, about 2/3 cup per pair)
Measuring cups
String (enough for 3 feet per pair)
Scissors



Procedure:

1. Discuss with students the great size shorebird flocks can attain during migration. Have older students read the "Sampling Populations" sheet which follows these directions. Are they ready to try and count big numbers, or do they want to learn some "tricks" to make it easier?

2. Form students into groups of two, and ask them to take out a piece of paper (one per pair).

3. Have each pair of students measure and cut two pieces of string about 18 inches long.

4. Have them each measure out 2/3 cup of beans. Tell them that each cup holds a ***population*** of "shorebirds" and they need to find out how many there are. If enough measuring cups aren't available, or students are younger, give them each a 5-oz paper cup nearly full of beans.

5. Ask them to quickly write down, for Number 1, their best guess as to how many birds they have. Each member of the pair may have a different guess.

6. Now have each pair spread their birds out on the mudflat which is their desk. Encourage them to spread them, with none piled up, in an area anywhere from about 12 to 18" square.

    7. ***Optional:*** Set aside five beans. Concentrate on what five beans look like. Now try "dividing" the whole bunch of beans with your *eyes* into groups of five. Count those groups of five as best you can, either with or without using your fingers. In other words, count by fives. Don't worry about getting the number exactly. Students might even be encouraged to race through this step. Repeat, using groups of ten instead of five.

8. They should next divide their birds into two sections, as alike in size as possible, by laying a string across the center (bisecting). Lay the other string across at right angles to the first. Now the beans should be divided into four sections of approximately equal area.

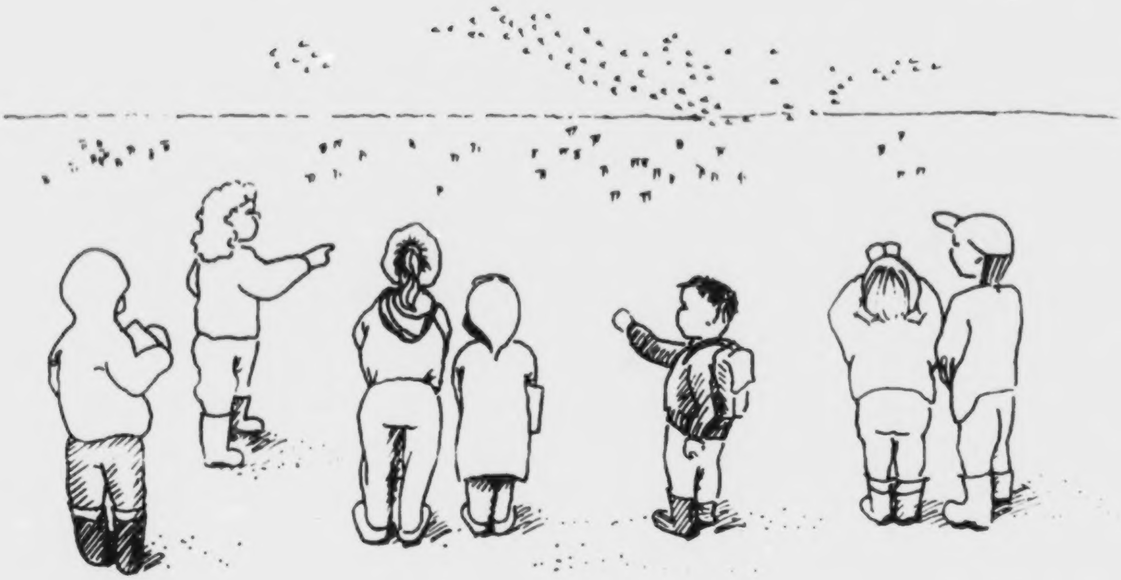
9. Ask students to count all the birds in one square. Write down the number. Multiply this number by 4 and write down the number you get.

10. Now have them count and record the number of birds in each of the other three squares. Add these four numbers together and write down the result.

11. Ask students to look at the answers that they got and compare them. Discuss the results as a class. Which was closer to the actual number - their guesses, the sum of the four counted areas, or the result of multiplying the birds found in one quarter of the area by four? Who guessed high and who guessed low? How can we tell how many bird beans the entire class has without counting any *more* beans? (Count the number of pairs of students, and multiply that number times the number of beans your group has. This works only if every pair has approximately the same number of beans, of course.

    Tell students that when they look at a real flock of shorebirds they won't be able to divide it with string or even fences. They will have to use their *eyes* to divide either the flock (beans) or the beach (area of desk that encloses all beans) that the flock is on into, say, five or ten equal groups of birds, and then multiply to obtain the total.

12. Practice the counting procedure on a field trip to observe migrating shorebird flocks. If such flocks aren't seen, have the students try counting trees in a park or people in a field.



Extensions:

1. **Divide Again.** After dividing the beans into four sections with two strings and multiplying, repeat the step using three strings to divide into six, and four strings to divide into eight. Also discuss the effect of the different bean counts in "corners" of the spread of beans with the bulging central sections.

2. **Make Transect Frames for Viewing.** In ***field work*** (conducted in the natural habitat of the organism), a ***transect*** is a way of dividing habitat into small, representative ***samples*** of the entire area. A study of the sample is far less time-consuming, and perhaps expensive, than a study of the entire area or population. If we assume that the sample is very similar to the rest of the area, then anything we learn from the sample helps us understand the total.

   Make ahead of time, or have students construct, transect frames ("windows") of approximately 2" square out of paper or cardboard. Repeat the bird bean counting following these steps: 1) measure the height and width of the spread of beans, 2) calculate how many 2" transects are inside of a square of this size (or simply rotate the transect around the pile, counting how many times it fits), 3) count how many beans are in one square, and 4) multiply the number from step 2 with the bean count from step 3.

   Transects can also be used on field trips to examine, say, the invertebrates in a beach sample. Students can toss their frame out randomly three times and examine what is found within the sample. Compare the samples or average together if they are all located in the same *tidal zone*.

3. **More Species!** For more of a challenging and realistic experience, and to test for *bias*, try mixing three kinds of beans (e.g., kidney, pinto, and navy). Also try counting them against different color paper backgrounds which match either the light or dark colored beans.

4. **Advanced Questions.** Censusing is a commonly used method in wildlife biology and game management. Discuss with students, or invite a wildlife biologist to the classroom to discuss, the reasons why censuses are important.

Encourage a thinking process which follows through beyond brainstorming to get to realistic evaluations of research methods and plans: What does a census tell us? (The number present in one place at one time.) What does it *not* tell us? (The *significance* of this number, for instance, whether a population is healthy or not. We need some baseline data to compare it with.) How is census information useful to humans? (Often it is most useful when *compared* to other information, like number present in other areas or number present in the same place in a different season or year or weather condition.)

Your discussion may include terms like *change over time*, *population trends* (declines or growth over time), *interyear variability* (differences between years), *intrayear variability* (differences within one year), or *baseline data* (initial or historical information, often presumed to be taken at a time of typical environmental conditions and useful to have to compare with in the future should there be a major or catastrophic event like El Niño or an oil spill).

- Student Reading -

SAMPLING POPULATIONS

- **Why do biologists count birds?**
- **What are some of the difficulties in counting birds?**
- **What use is this information?**

Total size of a population is difficult to obtain for species with thousands or millions of individuals (especially when what is being counted can move!). Biologists therefore *estimate* the number of animals in a given population. Shorebird populations can be estimated at migratory stop-over sites. Populations present in broad breeding or wintering areas are much more difficult to count because the birds are more spread out. Knowing the changes in numbers of individual species and populations permits more successful management of shorebirds and their habitats. Careful counts can help biologists note serious declines and offer appropriate protection.

Estimates are more than a random guess made by researchers. Biologists watch and become familiar with the behavior of the species they are surveying, study photographs of a known number of birds at various densities, and practice making estimates via computer-generated models and exercises.

Mistakes can occur when there is *bias* or *sampling error*. Bias occurs when some characteristic of a population causes it to be over- or under-represented. For example, in an estimate of a flock of mixed species, the estimate would likely be less accurate for small, drab-colored, hard-to-see species (or whatever characteristics are less conspicuous in the particular environmental conditions). One type of sampling error, observer variability, occurs when individual observers regularly make incorrect estimates. Look at the following numbers observers recorded while counting the same flock of birds:

Observer 1	246,000 birds	Observer 4	638,400 birds
Observer 2	638,100 birds	Observer 5	1,452,800 birds
Observer 3	638,900 birds		

From this example, we can see that observers 2, 3, and 4 do not show much variability, but observers 1 and 5 show great variability when compared to other observers. Some observers regularly estimate too high of a number, others too low. If you are making important counts, its good to know what type of observer you are. Let's try some techniques to learn to count large numbers more accurately.

- Student Worksheet -

BIRD BEANS

Directions: Pretend that the beans you measure out are a flock of shorebirds. Follow your teacher's directions to try and "count the birds." Use this page to record your answers.

1. How many birds do you *guess* are in your cup?

Name:________________ Guess:________________

Name:________________ Guess:________________

2. How many groups of 5 birds do you have? ____________________

3. A. How many birds are in *one* (of the four) sections?__________

B. Multiply the above number by 4:

____________ x 4 = ____________________
(Number in 1 section) (Number of total birds)

4. Count the number of birds in the other 3 sections and add them together to get the total number of birds:

_________ + ________ + ________ + ________ = ________
(Total number of birds)

5. Was your guess too high or too low?

____________(Name:______________________)

____________(Name:______________________)

- Activity -

BANDED BIRDS

Background:
Banding is an important method of capturing and marking birds for study. It allows for up close examination of live birds, often the only way of determining sex, age, race, and breeding condition. Because many members of a single shorebird species look deceptively alike to humans, banding allows individuals to be told apart.

When banding and observations are carried out in many places in the world, important information can be gathered about migration routes, destination, and behavior. Banding individuals is one of the most important tools in studying many aspects of behavior and biology of birds in their natural habitat.

It is often impossible to capture and mark an entire ***population***, be it a group of shorebirds that breed locally, a group using the same migratory flyway, or other designated population. If a large enough ***sample size*** can be studied, it is not always necessary to study the entire population. Sample size means the number of objects in a study. It refers to the fact that scientists can seldom study every single member of a population. They therefore select a random sample of the population, hoping that information gathered about the sample will accurately represent the entire population. Banding is a proven method for marking and studying a selected sample of birds, when otherwise we humans might not be able to find or tell apart members of the whole group.

Grade level: 2 -12 (see appropriate Alternative below)

Objectives: Learn the process of bird banding. Recognize bird banding as a research tool. Practice the scientific inquiry method, including forming research questions or hypotheses, making observations, presenting results, discussing findings with colleagues, drawing conclusions, and developing and directing new questions based on what has been learned. Practice ***"field work"***, which means research carried out in the natural habitat of living organisms (versus the laboratory). Practice skills of comparing, data collection, data entry, group cooperation, and presentation making. Optional: practice graph-making and calculation of percentages, and explore the statistical concept of *sample size*.

Duration: Varies (see Alternatives below)

Materials:
ruler
colored construction paper
masking tape

Optional: clipboards or shorebird notebooks (one can be constructed from several sheets of 8 $1/2$" by 11" or smaller paper stapled in the middle and folded in half).

Procedure:

1. Begin with a class discussion on bird banding. **Possible discussion questions** (adapt as appropriate):
   - Why is it important to be able to track where shorebirds or other animals migrate to? (Learn what habitats they depend on; learn how and where different sexes, age classes or populations interact; etc.)
   - How do biologists know where birds migrate to?
   - Is it possible that different *populations* (in this case, groups made up of a single species of shorebird) of the same species act separately, behaving differently or relying on different places during their lives? (Yes.) How do biologists know which individuals go where, since most members of the same species look, at least at a distance, alike to us?
   - How would marking birds *facilitate* (help) the gathering of information?

     Examples:
     When a bird is captured and examined closely, a researcher can sometimes tell such things as its sex and whether it is a juvenile or adult. The researcher also records where and when the bird was captured. If the *individual* bird is marked with a numbered band, and only it has that number in all the world, then if it is captured by a net again or recovered by a hunter, its number and all the original information known about it can be looked up. Combining the first set of data about the bird with the new set can tell us such things as how far the bird has traveled or how long it's lived.

     Large numbered markings, visible from a distance, can be used on big birds like geese, but to read the number on a little shorebird band, the bird would have to be captured, which is often difficult. Another method of marking is to use *color bands*, arranged in original combinations. This way, individual shorebirds can be identified by looking at them from a distance, without having to be captured and held in the hand.

     A third method of marking is to mark an entire group or population with one particular color of band or paint. For instance, if a population of Black-bellied Plovers in Nome is marked with spots of red paint, and a red-spotted Black-bellied Plover is glimpsed later in Hawaii, one might determine that at least some of that species which winter in Hawaii migrate to the Nome area. If red-spotted Black-bellied Plovers are seen at several, widely-flung areas, we might assume that the Nome population winters over a large area or *range*.
   - What are some ways which birds can be marked without interfering or altering their behavior? (Banding, dyeing a patch of feathers, radiotagging.)
   - Can you think of other important information to be gained from marking individual birds or being able to tell populations apart? (Learn how long birds live; how large their territories are or how they interact, the extent of *site fidelity*, if they return to the same area to feed day after day or same area to breed year after year; if juveniles return to the area where they were hatched; how quickly the population migrates from one habitat to another, etc.)
2. Explain that students will have the opportunity to see what it's like to be a bird bander as well as a bandee. However, since it requires special equipment, special permits from the federal government, and lots of training, they will not actually be banding birds; they will be banding each other!

Following are three alternative ways to proceed with the activity. Choose the method that's most appropriate (for your class level, shorebird unit, time allotment, school schedule and routine, and class/school size).

"BANDED BIRDS" ALTERNATIVE 1:

In-Class Study of "Banded Birds"

Grade level: 2 - 4

Duration: One 20-minute class period

Procedure, continued:

3. Have the students make construction paper bands:
   Have a choice of many colors available and pass out two pieces (mixing colors randomly) to each student. If you have a big class or not many colors available, pass out three colors to each student (this will allow for more combinations by placing them in different orders, as you will see). Have them measure and cut out one 1" x 7" strip of each of their two colors. These are their "bird bands".

4. Tell students that they are going to "band a bird," in this case the student next to them (or count off by 2's, form the students into two rows seated on the floor closely facing each other, and have the pairs facing each other band each other):

   Using small pieces of masking tape, they should snugly fit one strip around the wrist, and then do the same with the other strip, securing it above (toward the elbow) the other one. Make sure they will remain visible (so place *over* any long-sleeve clothing) and won't slip over each other (they can be taped together, one above the other, if necessary). Each student should have a different color combination.

   Now tell them that they are banded birds, and will be known today by their color combinations, for example "blue over red", "red over blue", or (if three colors were used) "red-green-yellow". Discuss how if someone (for example, a scientist or researcher who was watching their behavior) didn't know their names, s/he could tell them apart by their color band combination. This is how we tell birds apart, when they otherwise might all look alike to humans.

5. After all the birds are banded, tell the students that the shorebirds are now going to be observed or "studied" in their natural habitat:

Clear the desks away, or lead the class to a large open area. Tell the students that the room is now the world of a shorebird. Designate one end as the "North"; where shorebirds nest; the opposite end as the "South", or "Wintering Area", where shorebirds spend the winter resting and eating; and the middle of the activity area as the "Migration Route", which is the flight path shorebirds take to travel in between, stopping once or twice to eat before flying again.

6. Divide the class into three groups, and have each group move to a different one of the above shorebird habitats and begin behaving like a shorebird:

   Those banded birds in the Nesting area should sit down on the floor as though they are on their nests. Those on the Migration Route should flap their arms or make eating motions. Those in the South should make eating motions or pretend that they are resting on one foot or asleep.

7. Ask the class questions which require them to look over each other and make observations:

   Examples:
   Is "yellow over white" migrating or nesting? Is "red over green" a male or female? Which nesting birds (answer with band combination) have blonde feathers (hair?). Which migrating shorebird is flying (flapping) fastest? How many wintering birds with green bands are there?

8. After a few minutes, have the birds all "migrate" to a different habitat and continue with more questions. Repeat this a few times.

9. Have the birds all sit down and discuss their observations. Some Discussion questions: Did any birds lose their bands? Do you think you could keep your bands on all day? Were any colors hard to see? Did any birds have the same exact color combination, or confusing combinations? Was it hard for everyone to see all the birds all the time? What would this be like if you were real birds and biologists? What problems might you have?

"BANDED BIRDS" ALTERNATIVE 2:

Careful Observations At Specific Times Over the Course of the Day

Grade level: 5 - 12

Duration: One 15-minute class period for introduction and preparation
Up to one full day of regular activities during which 5 simple data entries will be made
One 45-minute class period for presentation of results and discussion

Procedure, continued:

3. To each student, assign the name of one other student (this can be done, for example, by choosing names from a hat).

   Tell the students that the name drawn will be the bird you have banded, or your "study subject", the shorebird individual that you are going to learn about through observations as it migrates its way around the class or school.

4. Tell students that they are going to see if they can locate their "bird" and record what the bird is doing.

   Tell them that they will be given 5 tries (which occur during the remainder of the day or tomorrow's school day). If the study subjects were real shorebirds, the times might be the times of high or low tides, or early morning hours versus afternoon hours.

   Younger Students
   Give younger students two - three category choices of activities like "walking", "talking", "writing", "sitting", "none of these", etc.

5. Have the students take out a piece of paper, or their shorebird field notebook if they have one, and instruct them to draw up a ***data sheet***:

Example 1:

Data Table
Showing What My Banded Bird is Doing at Certain Times of the School Day

TIME	walking?	talking?	both?	neither?
10:15				
12:35				
1:00				
2:10				
2:30				

Example 2:	
Data Table *Showing What My Banded Bird is Doing at Certain Times of the School Day*	
TIME	**Description of Activity**
10:15	
12:35	
1:00	
2:10	
2:30	

Ask students to give the table an appropriate, descriptive name. This will encourage them to keep focused on the data question, and to practice the science skill of clear labeling.

6. At the appropriate times, each student is responsible to attempt to observe his/her bird. At that time, the student should either record in words what the bird is doing or, if given categories, simply check off the box which indicates what the bird was doing.

7. After the 5 observation times have passed, have the students report on their findings:
   Possible methods of reporting:
   - You may choose to have them pool the data on a large data sheet drawn on the board. and determine such things as what was the most common activity, or if there is any pattern of activity according to time of class day.
   - A graph exercise may prove to be a good way to study the results. For example, identify the most common activity and have the students construct a bar activity comparing how often it was seen at each time.
   - You might also have students practice preparing and using percentages. For example. what percentage of the birds were not seen at each time, or what percentage of the students didn't observe their bird all five times.
   - If students recorded more of a variety of activities than can easily be pooled, have them present their results by each writing a paragraph about what they learned about their "bird," or about their own observation techniques.

8. Have the students discuss their findings and draw conclusions.
   Possible Discussion Questions:
   - Was it easy to find your bird at the appropriate time?
   - How did your bird's activities compare to that of other birds?
   - Do we know what was going on (e.g., lunch, math period, P.E., class break) in the school or class during each time, and do you think that might have a relationship to any results (e.g., was there more running during lunch, or talking during art?).
   - Did you notice any patterns of differences between males and females?
   - Do you think you got an accurate picture of what your bird does during the day?
   - Was the *sample size* sufficient to give an accurate picture of student activity?
   - How could the plan we followed be modified to really learn something about the activities of students in the school? (First, come up with a study question or hypothesis. Then decide when and where would be the best times to collect data.)

“BANDED BIRDS” Alternative 3:

Set up Data-Collecting Stations (“Mist-Nets”)

Grade level: 5 - 10

Duration: One 25-minute class period for introduction and preparation
Up to one full day of regular activities during which one or two 5-15 minute time periods are alloted for those students designated as “researchers” to gather data on their classmates
One 45-minute class period for presentation of results and discussion

Procedure, continued:

3. Review the ***method of scientific inquiry.***

4. As a class, brainstorm and select an interesting research question, such as:
How long do students spend eating lunch? Do girls or boys take longer to eat? Where are the students from this class during the last period of the day? What percentage of the students from this class leave the building at the end of the day by the front door? By the back door?

   Research questions should be fairly specific, but more than one question may be pursued during the data collection, as is often done in scientific research.

   Tell the students that they will be *collecting data* to answer their question(s). Remember that students need to be available (i.e., not in another teacher’s P.E. class) to collect the data at the appropriate times.

5. Divide the class into “researchers” and “migratory shorebirds” with a ratio of approximately 1 researcher to 5 birds. All the “birds” in this class will be banded. The other students in the school will also be thought of as “birds”, but they will be considered unbanded. Alternatively, all students in the school wearing red on their shirts, etc., could be considered “banded”. Decide ahead of time what works best for your school and classroom situation, but remember that the banded birds should be a representative random sample of students. After the activity discuss whether or not your ***assumption*** that you picked a truly random sample was correct. For example, if you choose hat-wearing students to be the birds, will you be biasing your sample in favor of boys?

6. Allow time for the researchers to get together and decide on where they will set up their imaginary ***mist-nets*** to best observe and catch birds:

   Example:
   Researchers can stand in a selected hallway to “catch” migrating shorebirds (as students pass, briefly stop all banded students one at a time), recording the number and color of the band, the time, location, and whether or not they had been caught before (a “recapture”), and any information necessary to the research question. Perhaps they can stand by the lunchroom and ask departing “birds” if they ate a vegetable or whether they had a brown-bag or hot lunch. Help them to design and prepare data questions or actual data sheets at this time.

Older/Advanced Students or Extended Projects:
Because birds are not usually confined to hallways when they travel, and they may fly over or round the mist net, student researchers may agree to accept a handicap, such as only stopping every fifth banded bird that passes them.

At the same time as the researchers are meeting, have the shorebirds write up "banding permits" which give permission to do the activity and are to be given to each researcher.

7. Have "researchers" band the "shorebirds":
Use masking tape to attach numbered construction paper anklets or bracelets. Instruct the "shorebirds" to go through the school day in their normal fashion.

   Notes: Class decides ahead of time whether to band on the ankle or wrist, because all "birds" must be banded on the same place since they are being banded by the same team of researchers. In real life, several different researchers, even in different countries, may be banding, and they can more easily tell "their" birds apart at a distance if they are banded in a consistent place or with similar-looking bands.

   If several classes at once are participating, use different color bands for each class. If a large percentage of the students in the school are participating in the activity at once, the number of banded birds should be reduced to 2 out of every 5 because in real life researchers can seldom band an entire population.

8. At the time(s) appropriate to answer the research question(s), allow time for the researchers to set up their imaginary mist nets to "catch" migrating students and record the data.

   Emphasize to the student shorebirds that they shouldn't change their daily activities on account of the research project, or they will risk providing invalid ("bad") data.

9. The next day, divide the class into cooperative groups, with at least one researcher per group. Have the students organize the data, with "shorebirds" helping "researchers", and present their findings to the class. Have students 1) refer to the original research question, 2) present results, preferably using a table or graph (have students pool the data on the board), and 3) draw a conclusion which refers back to the original question or hypothesis.

   Possible methods of reporting:
   This can be a good opportunity to incorporate math skills, such as fractions, probability, and graphing. Students can determine if a pie chart, bar graph, or line graph is the more appropriate way to clearly convey their comparisons or result and conclusions. Students can calculate what percent of all "shorebirds" migrated outside during lunch and what percent were caught by the library, then graph the results.

10. Some questions may require more "field work" to collect data. If any new banding is required, students need to request a new banding permit.

11. Have students do a "fast-write" (allow 10 minutes for writing up a page-length response to these prompts or questions) on what they learned about students or about their own observation plan and skills in this activity:

Examples of Prompts:
Do they think results would differ on different days? Did they encounter any significant problems? What would they do differently? Did they collect enough data (was sample size sufficient?) to answer the question? Did new questions arise? What other questions about student behavior could they answer this way?

Have them complete these papers (to be graded on participation) before continuing on to a class discussion.

12. Discuss the activity with the class. **Possible Discussion questions:**

- **Discuss the process of scientific inquiry. How did students use the scientific inquiry method to answer their research question?**
- **Ask "researchers" to share some of the problems they encountered in banding "birds". Compare these to the problems bird banders might face. Discuss the benefits and limitations of obtaining data on birds from banding. What similarities exist between this activity and what bird banders do? What differences exist?**
- What are some basic categories of data that most bird banders try to collect? (Date, time, age, sex)
- Did the research answer the original question?
- Why is cooperation and sharing of data important in any study such as this?
- Who else might be interested in your findings?
- **How could the study be improved to increase the accuracy of the findings?**
- Do scientists know all that needs to be known about bird migration?
- **Why is it that we don't know many exact details about where individual birds (or whales or walrus** or certain insects or many other aquatic animals) or populations spend various parts of their lives?
- **For how many years do scientists have to band and catch birds before they obtain sufficent** information on bird population *trends* (declines or growth)? (At least two, so the data from each year can be *compared*).
- Before participating in this activity, what would you have done if you found a dead bird with a band on its leg? What would you do now?

Extensions:

1. **Field Trip to Banding Station.** Visit a bird bander in the field, or invite one to come to your school to demonstrate equipment. Unfurl a net to "hook" the students' interest. Banders tend to be most active during the spring and fall migrations. Your local state or federal wildlife agency's migratory bird department, or a local bird observatory or wildlife refuge should be able to direct you to a bird bander.

2. **Repeat and Compare.** Repeat the banding activity another day and compare the results.

3. **Human Labels.** Brainstorm or discuss with students ways in which humans are labelled or marked, whether for study or as an aid in daily life (e.g., name, Social Security Number, library card, residency status for the Alaska State Permanent Fund, medical I.D. tags, "dog tags" for soldiers.)

Adapted in part from Gilchrist, et.al., "Buddy Banding", One Bird - Two Habitats.

GEE WHIZ FACTS: *MIGRATION*

Did you know that...?

Shorebirds that breed in Alaska migrate to Australia, South Pacific Islands, Africa, Southeast Asia, the Lower 48 (contiguous) states, Central America, and South America to spend their winter.

Only seven species remain in Alaska in any significant number during the winter (Black Oystercatcher, Black Turnstone, Surfbird, Sanderling, Rock Sandpiper, Dunlin, and Common Snipe).

The diet of migrating Dunlins using Alaskan mudflats consists almost entirely of tiny clams.

Some plovers, curlews, and tattlers fly non-stop from Hawaii and other Pacific Islands to Alaska in two or three days, a distance of over 3,500 miles. (Use a shorebird or general bird guide to discover which species.)

Up to one-half of some migrating sandpipers' body weight is deposited fat that provides energy for long distance flights.

Sandpipers are genetically programmed to stop, rest, and replenish their energy stores in certain wetlands along the Pacific coast from South America to Alaska. If one of these wetland areas is lost to development, sandpipers that depend on that area might not survive to migrate further.

Western Sandpipers migrate over 250 miles per day between stop-over points along the Pacific coast flyway to Alaska.

Western Sandpipers stop to rest, feed, and replenish their energy reserves for 3 to 5 days in each stop-over point in their migration northward along the Pacific coast to Alaska.

There are only 50,000 to 80,000 surfbirds in the world, and over 12,000 are known to stop in Homer, Alaska during spring migration.

The total number of shorebirds along the Pacific Coast and worldwide is decreasing due to loss of wetland habitat.

ADDITIONAL ACTIVITIES: *MIGRATION*

1. **"Sanderling Seasons", Part I. 4-9.** *Sanderlings* are Arctic-nesting shorebirds found on most coasts of the world in the nonbreeding season. They undertake very long migrations to reach some of these coasts. This activity takes advantage of the wide geographic range of Sanderlings to allow students to practice geography and astronomy (understanding of seasons) skills.

Have students examine a world map and write down the name of a place (town or landmark name plus country) located somewhere on a coastline. On the same sheet of paper, have them write down a date of the year. Exchange papers. Next, the student must locate on the globe the place that's on the piece of paper s/he's been handed, and determine if it is closer to summer or winter in that place at that time. Would a sanderling's condition there at that time likely be breeding, nonbreeding, or migrating, or can you tell?

Older students can write down a list of 5 places and 5 dates.

2. **"Sanderling Seasons", Part II. 2-9.** Have each student write a paragraph or tell a story imagining what sanderlings are doing on the student's birthday.

3. **Migration Collage. 2-12.** Have students use magazine pictures or pictures they draw themselves to create a collage of a year in the life of a shorebird. The collage should include images representing breeding, migrating, and wintering. It should stress *habitat needs*. You may also wish to brainstorm about other important facets of a shorebird's life to include, like long-distance travel, eating certain food items, flocking, and behaving territorially. Have older students choose a shorebird species and research its life history before attempting the collage.

Field Trips

4. **"Sound Observations," Part I. K-8.** Many children respond enthusiastically to sound. This activity and the following one are designed to allow students to practice listening and focusing skills while learning something about shorebird behavior during migration. On a field trip to observe migrating shorebirds, have students listen for all of the sounds they hear around them (whether caused by animals, the surf, humans, the wind, etc.). Have the students record the sounds using either words or symbols, or even audio-recording devices. Afterwards, you may choose to have them discuss the sounds and either write or orally present a little story about shorebirds in relation to these sounds.

5. **"Sound Observations," Part II. 5-12.** On a field trip to observe migrating shorebirds, have students listen to and describe or record the sounds they hear shorebirds making. (Are there different sounds or do all the birds sound alike all the time?) Do careful observations yield any clues to what the sounds mean? (Does anybody notice a call that is associated with taking flight, flying, approaching other birds, alarm, etc.? Are any sounds repeated?) Back in the classroom, ask them to attempt to recreate the sounds. If the birds seemed quiet, you may choose to have them write a paragraph speculating why this was so. If the species of shorebirds observed were identified, have students do research in bird guidebooks to see how the vocalizations are described.

Younger Students

6. **Which Comes First ...(the Shorebird or the Eggs)? 2-5.** On one piece of paper, draw simple pictures of five objects that represent where a migrating shorebird is found and what it might see during a year of its life. Hand out a copy of the pictures to each student and ask them to start with the first picture and number them in order.

The pictures can include 1) a nest with eggs; 2) a nest with chicks (or a chick next to a parent); 3-5) a shorebird flying hard ("whew!") or a huge flock of many shorebirds; 3-5) outline maps of Washington, Oregon, California, and/or South America; 3-5) some Mexican or South American artifact (perhaps something you have studied in class, like a Mexican hat or a pyramid ruin; or even a nice worm taco!); and 6) a bird eating all alone (indicating that a nonbreeding shorebird is neither with a mate nor regularly in the tight flocks found during migration). You could also include a picture of an empty nest (which could come before eggs or after chicks).

You may wish to start younger students out by labelling the nest with eggs as #1, although obviously the "beginning" can be found anywhere along the cycle. There are also several ways to interpret the chronological order of the pictures, but encourage students to understand the basic *cycle* of breeding-migrating-nonbreeding ("wintering")-migrating-breeding-etc..

7. **"Musical Migration." K-6.** Have students play an active game to reinforce the concept that shorebirds experience three different "ways of life" during each year: 1) nesting, which involves finding a mate, 2) migrating, which involves long-distance flight and likely forming large flocks, and 3) wintering, which is a lengthy period of eating and relatively solitary ease:

Designate three sites in the classroom as 1) nesting, 2) migratory route, and 3) wintering habitat (this can be a much bigger area than the other two). Tell students that when they are in the nesting site they must stand very close to one, and only one, other "shorebird." When they are in the migratory route they must all bunch as close together as possible and pretend to sleep or eat. When they are in the wintering area they must stand very far apart and pretend to eat or sleep.

Have the students distribute themselves throughout the three habitats. Either begin some music or call "Migrate!" to indicate that they should quickly move to another habitat (flapping their arms vigorously) and establish the proper behavior and position. Stop the music or call "Stop!" Any student not in proper position is out for that round. Repeat several times.

8. **Shorebird Sister Schools Program. 2-12.** Have students use the Shorebird Sister Schools website to compile their own list of "Gee Whiz" facts of bird behavior, numbers, etc. on the topic of migration. (See page 169.)

Research Topics for Older/Advanced Students

9. Choose one shorebird species and research to compare and contrast the primary food items it eats during 1) the breeding season, 2) spring migration, and 3) the nonbreeding season.

10. Choose one local shorebird species and research to determine the extreme map locations (longitude and latitude or nearby town site) it may migrate between. Calculate how far it travels in one year (in other words, during spring and fall migration).

11. Research shorebird invertebrate prey items on coastal beaches during migration, and describe how the behavior of these invertebrates is related to the tides. Relate this to patterns of shorebird habitat use (territorialism vs. nonterritorialism, and crowding along the high tide line vs. spreading across the beach or flying elsewhere during low tide).

12. Research to find out what predators prey on migrating shorebirds in your area. Research sources include local outdoorspeople and elders, local wildlife agencies, and birding groups like the National Audubon Society.

KEY WORDS: *MIGRATION*

bird banding
bottleneck
circumpolar
color banding
estuary
field work
flyway
isotherm
limiting factor
market hunting
migration
mist net
mortality
population
sample
sample size
season
site fidelity
stop-over site
strategy
survivorship
population trend
urban expansion

- Activity -

SHOREBIRD SISTER SCHOOLS PROGRAM: *USING THE INTERNET and E-MAIL TO TEACH STUDENTS ABOUT SHOREBIRDS*

Background:
The Shorebird Sister Schools Program allows students, teachers, and parents to track Arctic-nesting shorebirds as they migrate north to their nesting grounds in Alaska and Canada. By tracking the super shorebird highway on the Internet, students will be engaged in learning about shorebird stop-over locations, shorebird ecology, the concept of migration, computer use, ecology, and ecosystems.

By using the Internet to view the Shorebird Sister Schools Program Web Page and subscribing to the listserver, you will have the opportunity to exchange ideas with other classes throughout the Western Hemisphere, share field trip information/data and any sightings of banded shorebirds, learn about shorebird research by tracking radio-collared birds, ask questions about what other classes are doing in the Shorebird Sister Schools Program, and ask shorebird ecology questions of other educators and shorebird biologists.

Students will be using the computer as a resource tool to learn about shorebirds, ecology, wetlands, other cultures, and ecosystems. While they are learning all this, they are learning new technology that will help them throughout their school years and beyond.

Grade level: 2 - 12

Objectives:
Learn about shorebird migration, ecology, and ecosystems in your own and other regions of the world. Communicate with students in other states, provinces and countries. Learn about the Internet and communicating via electronic mail. Practice computer and keyboarding skills. Practice written communication skills.

Key Words: web site, web page, modem, Internet, Internet provider service, browser, navigate, hypertext links, listserver, E-mail

BEST COPY AVAILABLE

Materials: Computer: monitor, keyboard, mouse, hardware computer, IBM clone or Apple/Macintosh with modem. Modem can be internal or external. The faster the modem the better. A 28.8 speed modem or faster is recommended.

Minimum computer speed of a '486' (preferably higher or the kids will lose interest because the pictures draw too slowly).

Internet Browser package, of which there are many types: Netscape, SPRY, Mosaic, Microsoft Internet Explorer, etc. Some are **free** to schools. There are also several on the market. Computer stores can also help you get the best one for your students.

Dedicated phone line for your modem. If your school has a sophisticated phone system, you will need one phone line to the outside that is not part of that system. Perhaps you have a computer lab with just that kind of setup.

Procedure:

1. Shorebird Sister Schools Program Web Page.

The Shorebird Sister Schools Program *Web site* is: http://www.fws.gov/~r7enved/sssp.html

To get to the site, where you can read what others have written or reported about shorebirds, you will have to start your *Web Browser*. Type in the above Web site (the entire line) wherever it asks you for a location or address. Then hit return/enter and the Shorebird Sister Schools Program Web site will appear on your screen.

To *navigate* around the various pages, you will need to click with your mouse on the colored, underlined text (*hypertext links*). This will take you to another page. There are two methods to return to the previous page: 1) click with your mouse on the 'back' button somewhere on the page or 2) click on the hypertext that says "Shorebird Sister Schools Main Page."

To quit the Browser program, click on the quit button or click on File, Quit/Exit in the menu bar at the top of the page.

2. Shorebird Sister Schools Program listserver/E-mail.

To use the *listserver*, you will need electronic mail capabilities (an *E-mail address*). This will allow you to send and receive mail messages from other students, schools, research biologists and other folks interested in shorebirds. For example, an E-mail address can look like this: sandpiper@western.flyway.net.

Depending on how your school is set up, you may have an *Internet connection* already or may need to sign up with an *Internet Provider*. Either way, check with your computer folks and they will help you receive an E-mail address.

Then each day you can check the mail and see what others have sent to the listserver. You will also be able to see what has been sent from your classroom.

This listserver is designed for quick, interactive communication regarding the migration of Arctic-nesting shorebirds, and everyone is invited to subscribe and post messages on this or related topics.

Instructions for signing up for a listserver once you have E-mail capabilities:

Send an e-mail message to **majordomo@www.fws.gov** with **subscribe fws-shorebirds-digest** in the body of the message.

Suggested Activities:

1. Get the students on the SSSP web site at least once a week to check on updates of ongoing research. Check more often during migration: those birds move fast!

2. Plan a field trip using the information from the SSSP web site and then "publish" your data by sending it to the listserver.

3. Find penpals through the listserver. Share with your penpals everything you have learned about shorebirds, habitats, etc.

4. Have the students think of good questions that they would like to ask research biologists and then send E-mail messages asking them for help with the answers.

5. Have the students use a large wall map to track the shorebirds as they are reported on their migration route. Refer to the poster included with this curriculum.

Additional Activity:

Build your own Web Page. 9-12. Build a web page about your shorebird projects. Include your species list, research projects, map of the area, particular habitat and local threat information, etc. Once your web page is complete and on-line, send an E-mail message to **heather_johnson@fws.gov**, and the U.S. Fish and Wildlife Service will make a link to your site.

FIELD TRIPS

CONTENTS:

- **Teacher Information**
- **Pre-Trip Activities**
- **Field Trip Activities**
- **Post-Trip Activities**

FIELD TRIP
TEACHER INFORMATION

Shorebird Peak Dates at Major Stop-over Locations Along the Pacific Flyway

San Francisco Bay, California	April 15 - 30
Willapa Bay, Washington	April 20 - 25
Gray's Harbor, Washington	April 19 - May 3
Fraser River Delta, British Columbia	April 22 - May 2
Stikine River Delta, Alaska	May 3 - 7
Copper River Delta, Alaska	May 4 - 13
Kachemak Bay, Alaska	May 4 - 13
Yukon/Kuskokwim Delta, Alaska	Mid to late May

FIELD TRIP CHECKLIST

____ 1. **Objectives.** Decide what the objectives of your field trip are and how you will integrate the field trip with your study of shorebirds.

____ 2. **Contact a resource person.** To locate a person in your area who is knowledgeable about shorebirds, try contacting state or federal agencies that manage wetlands in your area, local universities, or environmental education centers. This person may be able to visit your classroom, suggest possible sites, dates, and times for your field trip, or accompany your class in the field.

Consider involving a team of resource people, including local elders, birders (i.e., Audubon Society), or other outdoorspeople.

____ 3. **Select the site,** and

____ 4. **Select the date** for your trip (with alternates). The date you choose is especially important because at most stopover areas shorebirds are only found in large numbers for a period of one to three weeks, with a peak period of about five days. A successful field trip depends on your students being able to see the birds!

- ____ If you will be visiting an intertidal area, check a tide table. One hour after high tide is often the best time to see shorebirds, but consult local experts to be sure.
- ____ Obtain permission for your field trip if the site is on private property.
- ____ Familiarize yourself with the site and background information.

____ 5. **Arrange Transportation.**

____ 6. **Select activities** for use before, during, and after the field trip. This activity guide is full of ideas. Use these, gather ideas from other activity source books, or develop your own activities with the help of resource persons.

____ 7. **Prepare the schedule** for the field trip (see "Scheduling Suggestions"). In scheduling, consider small group divisions, distribution and use of equipment, travel time, timing of activities, and rainy day alternate activities.

____ 8. **Recruit assistants** among teacher aides and parents for help during your field trip. We suggest a 1:5 ratio of adults to students. If possible, all adults should visit the site before the field trip. Be sure that the helpers understand their duties, and if possible give them copies of the schedule, trip rules, etc. before the trip day. Emphasize that their preparation and commitment will create a fun-filled learning experience.

____ 9. **Give instructions to the class.** Let the class know where they are going and the behavior that is expected of them (see "Field Trip Etiquette").

  ____ Discuss etiquette and safety with students.

  ____ Give the students a list of what they need to bring along, including proper dress for the location and conditions.

____10. **Send home permission slips.** Be sure to get emergency medical information for all students.

____11. **Gather, make, and practice using field equipment.** Directions for making and using some suggested field equipment are included in this activity guide. Some students will be able to bring binoculars and bird field guides from home. Make sure before you leave the school that all binoculars have straps and that the binoculars and books are all marked with the child's name.

____12. **Research and discuss shorebirds with your class**, including identification, natural history, migration, and habitat.

  ____ Plan and complete pre-trip activities.

____13. **Assign responsibilities and tasks.** Assign all students (either individuals, small groups, or the class as a whole) particular responsibilities for the field trip. You may have all the groups conduct the same activity, or each group may do a different activity. Assigning tasks helps ensure participation by all students.

____14. **Copy data forms and make field journals.** Make sure students understand how they are to be used in the field.

  ____ Create a field journal that students can use to record field observations and data. Data sheets included in this activity book can be copied. Use waterproof paper if available. A stack of 5 blank sheets can also be stapled in the middle and folded to form a 10-page book.

  ____ Clipboards are handy to hold journals and data sheets. Mount a pencil to each board with string and tape.

____15. **Practice the field trip.** The day before the trip, have students bring appropriate clothes and gear. On the playground, simulate the field trip to familiarize students with the equipment and tasks.

FIELD TRIP SUGGESTIONS

The purpose of a field trip:

When planning, keep in mind the general objectives of field trips:

- An opportunity to *experience* (i.e., see and hear) living shorebirds, particularly in their natural environment.
- An opportunity to practice methods of scientific inquiry while conducting "field (versus laboratory) research." These methods include observation, data collection, and team work.
- An opportunity to consider, through direct experience, the interactions between wildlife and humans. Interactions may include enjoyment, disturbance, and education.

When planning your trip:

Familiarize yourself with this shorebird activity book. Activities which involve field trips or data collections and observations made during field trips are presented in all of the chapters. Plan so that a variety of such activities can be accomplished on your trip, especially if you will only be taking one major field trip. Take into account such factors as the tide levels, shorebirds' season, and fragility of the habitat (i.e., how much room students will have to spread out or work).

On the way to the field site:

If you cannot walk to the area, plan some lively games or songs for the bus trip, so students burn off a little excess energy and will be able to concentrate on their discoveries once they reach the site. A good bus ride activity is a "scavenger hunt" for items (e.g., stop signs, certain tree or animal species, wetlands, examples of recent habitat degradation) the bus will pass along the route. Make up checklists ahead of time, then have a prize for the individual or group that sees the highest number of items on their list.

Arrival at site:

Before letting students off the bus, remind them of the trip rules and proper outdoor etiquette. You may also want to assign them an initial short, fun, discovery activity to get started on as soon as they alight. For example, modify one of the activities in this book, or allow 5 minutes for each student to explore the area and then 5 minutes to draw a picture of the site. Save these to compare to pictures or lists they make at the end of the trip. Some of the "Post-Trip Activities" and activities elsewhere in this book require sketches or written observations from the site. Be sure to plan ahead for these activities.

Close-up studies:

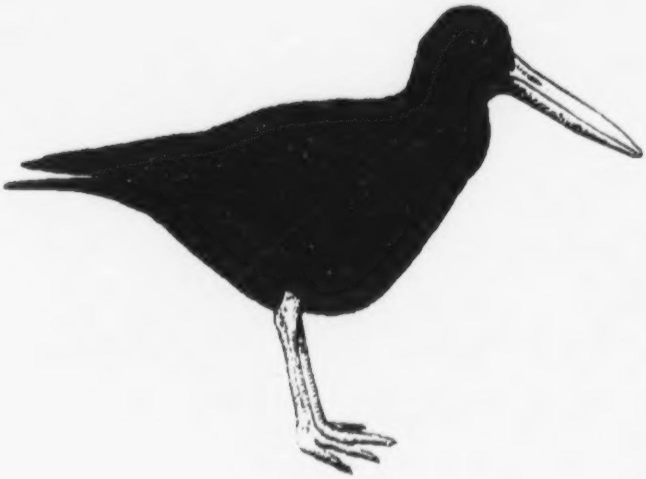
Have individuals or small groups conduct special investigations. Allow 45 minutes or so for each close-up study. You may choose to have all the groups conduct the same activity, or you may assign each group or student a different close-up study.

Sharing:

Gather the class together again, and have each person or group give a short summary of what s/he learned or saw, and point out or show things of interest. It's important to do this briefly at the site so that all students have an opportunity to notice the items they didn't examine closely. It's also a chance to find out how observant students were. Once a group gives their summary, other students might add their own observations on the topic. Students can also be given a chance to write in their field journals.

Pollution patrol:
Before departing. be sure any living creatures you collected are returned to the place where they were found. Have students go on a pollution patrol with a garbage bag to pick up anything the class and other people left behind. You may want to award a pollution patrol prize to the group that collects the most.

Follow-up:
There are several follow-up activities included in this guide that will help students a) learn from their field trip, and b) move from "awareness to action." These activities can be used to wrap up the unit and put it all together for students. You will probably want to compile and discuss data that was collected. Try to have the resource person visit the classroom to help discuss the findings.



Adapted originally from Quinlan, Alaska Wildlife Week.

GROUP MANAGEMENT HINTS

If you have apprehensions about leading a group of children away from the four-walled constraints of a classroom, relax! There are several techniques you can use to help keep the group's attention and maintain the feeling of freedom and open exploration. Try the following:

- When you stop to look at something, gather the group in a semicircle with everyone facing inward.
- Speak loudly and clearly, facing the group. Wind will carry your voice away from anyone you aren't facing.
- Make eye contact with the students.
- You, not the students, face the sun.
- Focus on something specific when you stop. Vague discussions will lose the group's interest.
- Talk with, not at, the group.
- Stimulate imagination and excitement while delivering factual information about the organism.
- Be versatile. Recognize the magic of the moment. Use unexpected experiences to illustrate ecological concepts, or just enjoy it.
- Keep it simple. Demonstrate as an activity is being explained.
- Encourage thinking and group interaction by asking questions. Leave room for imagination.
- Consider assigning tasks to all students (tasks may be general or related to activities).
- Bring with you, or assign a student to carry, an "emergency" supply pack with first aid kit, pencil sharpener, tissues, and extra plastic baggies.
- Enthusiasm is the main attention-getter. If you're not getting excited about it, will your students? Get down on your hands and knees to look at the plants or invertebrates. Study an animal by being it (move as it does, sound like it, or try to look like it), especially if you don't get to see the animal. Point silently at a feature to which you want to draw attention. Enthusiasm is a greater catalyst than knowing all the names.
- Keep the group together with creative ways of moving from one spot to another. For example, everyone might use an animal's traveling method to get from point A to B. Run like a mouse. Creep like a snake. Fly like a shorebird. Do it with your students.
- Remember that as the leader you set the tone for the experience.

Adapted originally from "Safety", Salt Marsh Manual: An Educator's Guide.

FIELD TRIP ETIQUETTE

Promote conservation! Conservation is the protection and wise, sustainable use of natural resources. A visit to any natural area can be a very stimulating and exciting experience for any age student. However, all of us must be careful to remember that natural areas are habitat for wild plants and animals, so we as visitors should act like guests visiting or sharing someone's home.

Teach important field skills. A field trip is an excellent opportunity to teach students outdoor etiquette skills that they can use all of their lives and pass on to their own families and children. How can you help take care of animals, plants, and other organisms you encounter in your field and classroom studies? How can you keep from disturbing wetland homes? How can you learn more about your environment by observing it in its natural state? What can you do to ensure that enjoyable camping and other outdoor recreational activities do not harm wildlife or habitats?

We will see more if we are quiet. The site should be left as close to natural as possible, so that future visitors will be able to enjoy the area's plants, wildlife, and beauty.

For these reasons some rules are necessary when visiting a natural site. Here are some suggestions:

- Step softly and quietly while observing animals. Stay quiet. Yelling, shouting, and "roughhousing" will scare animals away, and may cause some to abandon their nests or young, or avoid the area in future.
- Replace rocks and logs after looking underneath (to keep the roofs on animal homes, and to keep people from stepping in the depressions left by the rocks).
- Handle animals gently. They have different anatomies than our own, and we may be unaware of ways they can be hurt. Any animals that students handle will probably be much smaller than us as well.
- Fill in holes after looking at worms or clams (to prevent suffocation of the animals next door, and people stumbling in the holes).
- Do not take live animals away from their homes.
- Do not litter.
- Pick up any litter you find. Carry a litter bag in your back pocket. This bag can also be used for any toilet paper you have to use.
- Minimize trampling of plants and fungi. If trails are designated, stay on them as much as possible.
- Even if shorebirds aren't nesting in your area, be aware that many other birds, whether in the forest, meadow, or marsh, or on the beach, nest on the ground. Remember that such nests and

the chicks are camouflaged from predators, and therefore difficult to see before one's foot is right over them. Always watch where you are walking, and keep pets leashed during the spring and summer breeding season. This is another reason to stay on trails.

- Never chase, repeatedly *flush* (cause to move away), or harass animals (whether on foot, in a car, boat, plane, all-terrain vehicle, or snow machine). Harassing animals is against the law in many states and may be punishable by a fine or jail sentence.

- Move slowly, allowing the animal to keep you in view. Avoid sneaking up on or surprising animals. The following are signs that you may be too close to birds:
    Head raised, looking at obervers
    Skittishness
    Excessive preening or pecking at dirt or foot; bill wiping
    Alarm calls; repeated chirping and chipping
    Distraction display: broken wing, tail spread, etc.

- Teach students that if an *active* nest (one with eggs or chicks or that looks new or under construction) is ever encountered it should never be touched, and when they move away from the nest they should do so *by continuing to walk in the direction they were originally going*. In other words do not leave a one-way or V-shaped scent trail to a nest. This is because predators are smart and not only sometimes watch people (have you ever been watched or followed by a raven or magpie?) but mammalian predators can *smell* your trail and follow it to a nest.

- Check state and federal regulations regarding collecting of plants or animals. In general, collecting of any kind should be minimized; have students make careful observations and detailed sketches in lieu of collecting. If you decide to include study of the birds' invertebrate food sources, limit the number of bottom and core samples taken, as these are very disruptive to the area. This is especially true of areas which receive a large number of visitors already.

- Bathroom stops should be made just before leaving on the trip and afterwards. However, teach children that if it is necessary to "use the bushes," *never* leave toilet paper scraps behind. (Ask students "How do you feel about a place when you come across toilet paper?") Used toilet paper should always be carried out in a plastic bag, and everyone should carry their own when a long trip away from facilities is anticipated.

- Before leaving, take time to assess the impact of your visit. Have students ask themselves: "Is this area as beautiful now as before my visit?"

FIELD TRIP SAFETY

Teach students about field safety (including what to do if they get lost) and hypothermia before going into the field. Consider inviting a resource person in to teach a class in survival skills. Resources to contact include the Red Cross, a Village Safety Officer, and the Coast Guard. Students and their adult leaders should know and understand the following safety rules before going out in the field:

- Stay together.
- Have a buddy, and understand the responsibilities of having a buddy: know where s/he is at all times, and report to the teacher immediately if something happens to your buddy.
- If you become lost, stay where you are and call out periodically.
- Dress warmly and keep dry. Encourage children to carry an extra pair of socks in their backpacks when visiting potentially wet areas.
- Know the dangers of , and treatment for, hypothermia. Take extra clothes, rubber boots and rain gear (plastic bags will do in a pinch).
- Step carefully around the water in wetlands. Because the ground is so mushy, you can get stuck. Always wear properly fitted and fastened life jackets in boats.
- Observe animals from a safe distance. Use binoculars, spotting scopes, and telephoto lenses to get a closer look. If an animal shows sign of being crowded or disturbed, sit quietly or move slowly away.
- Do not taste any wild plants. Some plants are poisonous and some people are allergic to plants that are normally harmless.
- Carry a first aid kit.
- Carry emergency medical information for each student. Be aware of special allergies or medical problems of all children and adult participants.
- Always know which students you have in your group. Carry a list of students and take frequent head counts. To prevent stragglers and explorers from getting lost, assign a leader and follow up ("caboose") person when traveling from one point to another.

VIDEO HINTS

While preparing for the field trip, teachers should seriously consider video taping. Video records can be fun for children, useful learning tools (what can be done differently next time?), part of a comprehensive display or "wrap-up and share" activity for the unit (see "Shorebird Fair" activity), or played at other school functions. Video recording can form a vital part of an activity (see "Additional Activities: Nesting and Breeding"). Students can also learn technical skills by operating video equipment and even incorporating their videos into computer programs. Finally, students enjoy using and posing for the camera, and this enjoyment may enhance their learning experience.

Plan on spending time getting familiar with the video camera to be used. The more one knows about the camera, the more fun and polished the production will be. Practice also allows the students to get used to filming or being filmed. Here are some suggestions to help make your video a hit:

Practice, Practice, Practice

Use a tripod

Use an external microphone

Avoid external, distracting noises (i.e., cars, planes, etc.)

Plan ahead: what do you want to show?

Use an outline to plan shots and sequences

Try to film beginning to end to avoid editing hassles in the field

Use a variety of shots, angles, distances

Mix close-up with mid-distance and scenic shots

When panning, go slowly; don't repeat back and forth

Start with an empty tape

Use zoom both in and out but with caution to avoid overuse

Have plenty of batteries

Start filming at least one second before talking

Include as many birds as possible

Interesting titles are important: have students make signs or verbal introductions

Concentrate on getting good sound, especially from students

Include important people: all students, elders, biologists, refuge personnel, teachers, parents

Protect the camera body and lens from water, raindrops, surf, splashes, drops

Show close-ups of hands, feet, faces, action

Include action and mood shots

Explain habitat type and something about the location

Explain what is being seen

Some filming can be done before and after field trip

Have a beginning and an end

Tell a story, present a message

PRE-TRIP ACTIVITIES

- Pre-Trip Activity -

FIELD GUIDE & GLASSES PRACTICE

Background:
This activity provides practice quickly and effectively using binoculars and field identification guide books. Using both can be a frustrating experience for those who don't learn some techniques during practice sessions. Once mastered, they provide wonderful tools for both science and enhancing a recreational outdoor experience.

There are other reasons to integrate field equipment into your activities. Student enthusiasm is often fired up by getting to use equipment, especially when there's enough for everyone. Binoculars and other field equipment (e.g., compasses and long tape measures) can be used to teach math and other skills in interesting, related activities. If birds are used as a theme to learn science, reading, geography, art, math, and other skills, a set of field guides can come in handy. And last but not least, shorebirds, because of their tendency to walk about in open habitat, are fun and relatively easy to get to know through the use of binoculars and field guides! If possible, consider obtaining a set of field guides and inexpensive binoculars for your classroom.

If you don't have access to one field guide and binoculars per pair of students, you can still do this practice field trip activity with students taking turns. Contact a local environmental education office, like that of the U.S. Fish and Wildlife Service, to ask about materials available for class borrowing.

Grade level: 4 - 8

Objectives: Become familiar with the organization of bird field guides. Become familiar with using field glasses (binoculars). Learn how to look for common field markings and practice identifying local birds. Practice working with a partner.

Duration: One 30 to 60-minute class period, depending on class size

Materials: Collection of 10-20 bird pictures, including shorebirds you are likely to see on your field trip. (Also include other types of local birds, or shorebirds and others which you aren't likely to see: make sure they all appear in whatever identification guide you use, and vary identification challenge with grade level)

Bird field guides (either local or North American: just make sure all of the birds in your pictures are identified in these guides)

Binoculars (also known as field glasses)

Teacher Preparation:
1. Mount color pictures of the birds you will be identifying in the wild. Include a few "*acci-dentals*" (birds that are normally not found in your area) for a challenge. Number each picture on the front. They can be collected from old field guides, magazines, or calendars, and if possible should show the natural habitat of the birds. Keep pictures hidden until you are ready to go on your practice field trip.

2. Prepare a list of birds that might be found on your real field trip.

Procedure:

1. Provide students with the list of birds. Using sticky notes or other means, have the students find and highlight the birds in the field guides. Read the information about each bird and discuss the field marks. Identify what makes each bird unique, distinguishing it from other birds.

2. Demonstrate how to use binoculars carefully and safely. The students should be appropriately awed by their value. Demonstrate how to focus the various glasses, and how to adjust for eye width and focus differences. Explain the magnification of each type.

3. Place the pictures you have kept hidden around a large room such as a gym, or outside on a school wall. Be creative: perhaps your class has had time to decorate the wall of the gym in a way that represents the habitat of the real field trip. Place the pictures approximately where you would expect to find the birds.

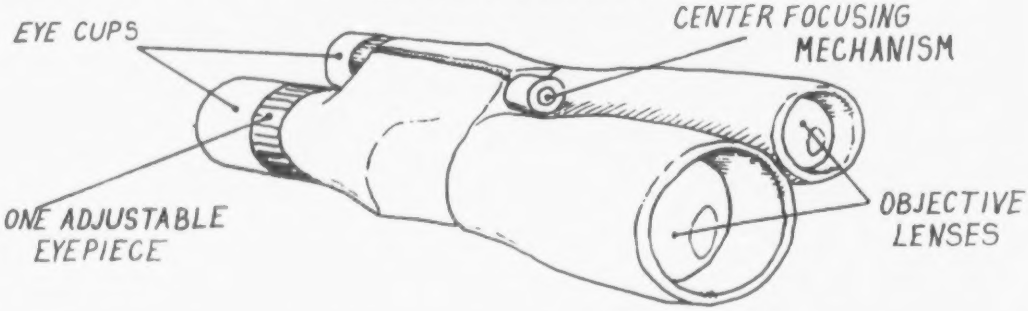
4. Identify a safe place for the participants to stand where they will not get stuck in the mud, eaten by bears, or run over by cars. This space should be far enough away from the birds that the students must use the field glasses to see the birds adequately.

5. The students will work in teams of two. The goal is for each team to correctly identify all of the birds. You can give a time limit if necessary.

Like on a real field trip, they will want to keep their voices very quiet, so as not to scare the birds (and not to give their answers away). They need to take turns with the binoculars. The person with the binoculars identifies field marks such as color ("I see a black spot on the chest") and size ("It has longer legs than the other birds"). The other person looks in the field guide finding potential birds, then sharing ideas with the partner. Students usually work out a suitable way to share the work: just make sure they take turns with the glasses.

Depending upon how many binoculars you have, this can be a whole group practice field trip, or several teams at a time can enjoy the field trip while the rest of the class works on another quiet activity. Parents who will help with the real field trip enjoy the practice too and can take part.

HOW TO USE BINOCULARS



Usually, we need to account for a difference in eye strength: Center-focusing binoculars have an adjustment to compensate for eyes of unequal strength or vision. You will notice that only one eyepiece is independently adjustable, and it has a scale marked off in *diopters*, the optical measuring unit for spherical power. Note that the individual eyepiece setting, once adjusted, can be considered permanent. The scale reading should be noted and checked occasionally as it may be accidentally moved by handling or in moments of excitement.

To adjust your binoculars for any difference in the strength of your eyes, first, using the lens cover or your hand, cover the objective lens (the outer, big lens) which is on the same side as the adjustable eyepiece. With both eyes open to avoid distortion by squinting, look through the binoculars and, using the central focusing mechanism, focus on a distant object until it is sharp and clear. Now transfer the cover to the other objective lens. Again with both eyes open, but this time using the adjustable eyepiece, focus on the same object until is is clear.

Your binoculars are now properly focused for your use. Now, all you have to do is use the central focusing mechanism to focus for objects at various distances from you.

Focusing on moving objects and focusing quickly on something that is about to fly or move out of view are real challenges. If you practice, over time you will be surprised to find how your coordinated use of eyes and binoculars improves. Be patient and practice, practice, practice.

Another challenge is finding and focusing on objects in the sky. This is because the sky has depth, and there is not a background of objects (e.g., trees, horizon line, etc.) to use as reference points which both find your object and figure out what distance it is at.

Note that many binoculars have rubber eye cups which can fold down for use with glasses or sunglasses.

Adapted originally from Wetlands & Wildlife, and from Molly Brenn, North Star Elementary, Nikiski, AK.

- Pre-Trip Activity -

MAP & MILES STUDY

Grade level: 3 - 9

Objectives: Part 1: Relate a map to actual location. Understand water flow through wetlands. Practice map-reading and application skills. **Part 2:** Understand expenses of using, and value of, nonrenewable resources. Demonstrate field trip readiness. Relate mathematical story problem to real life event. Practice map-reading, estimating, measuring, metric conversion, multiplication, and division skills.

Materials: Topographic map of the field trip site

PART 1: Map Study

Duration: One 20 to 30-minute class period.

Procedure:

1. Have students study a map of the site you will be visiting.
2. Help them to determine the type of wetland (see "Habitat" chapter).
3. Help them to determine the source of freshwater and saltwater.
4. Have them answer the question, "Which direction does the water flow?".

PART 2: Miles To Go

Duration: One 20 to 30-minute class period.

Procedure:

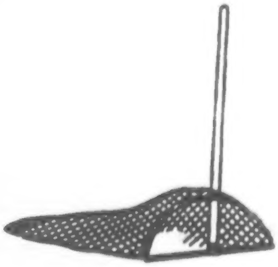
1. Have students determine, as closely as possible, the number of miles to the field trip site. Have older students convert the miles into kilometers, or vice versa.
2. Find out your fuel economy (how many miles per gallon your field trip vehicle gets).
3. Have students calculate how much gas (a nonrenewable resource) will be used on your trip.
4. Have students answer the question, "Considering the cost and use of nonrenewable resources, what can we do to get the most out of our trip?"

- Pre-Trip Activity -

MAKING SAMPLING EQUIPMENT

HOW TO MAKE A BOTTOM SAMPLER

INFORMATION SHEET



Materials: coat hanger, needle and thread, wire, 12-inch wooden dowel, broom handle or 3-foot long wooden dowel, nylon stocking or lightweight nylon (1 mm mesh or less).

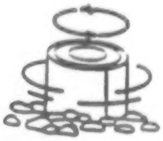
1. Constructing a net: cut off the top hook of a coat hanger and shape the triangle into a half circle, leaving the bottom wire flat.

2. Use a nylon stocking or a square of lightweight nylon material. Fold the square in half diagonally, then stitch up one of the open sides of the triangle forming a cone. Wrap the open end of this cone (or the nylon stocking) around the half circle of wire, then stitch in place.

3. Strengthen the straight edge of the half circle by wiring a 12-inch wooden dowel along it. Attach a wooden broom handle or long dowel to the center of this dowel and across the opening of the net.

HOW TO MAKE A CORE SAMPLER

INFORMATION SHEET

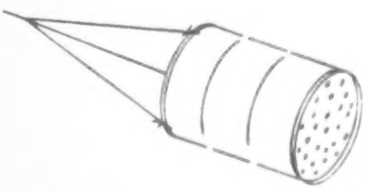


Materials: juice or coffee can, jar lid or flat piece of wood, sorting tray.

Cut one end completely out of a tin can, then punch a hole in the other end with a large nail.

HOW TO MAKE A BOTTOM DREDGE

INFORMATION SHEET



Materials: coffee can, heavy string, heavy fishing weight.

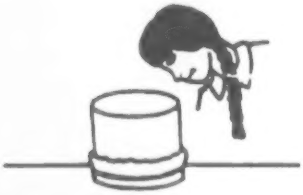
1. Poke holes in the bottom of the coffee can with a nail and hammer.

2. Use the same method to poke holes at the rim of the can to attach a bridle with which to drag the can through the water.

3. Put a heavy fishing weight on the bridle and attach the bridle to a tow line.

HOW TO MAKE AN UNDERWATER VIEWER

INFORMATION SHEET



Materials: large can or plastic container, clear heavy-duty kitchen wrap or other clear plastic, large rubber band.

1. Cut out completely the top and bottom of a large round can or plastic container. Be sure there are no sharp edges.

2. Stretch a sheet of clear plastic across the bottom and hold tightly in place with one or more large rubber bands.

Source: Wetlands & Wildlife. Alaska Department of Fish and Game, and U.S. Fish and Wildlife Service. 1990.

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FIELD TRIP
ACTIVITIES

- Field Trip Activity -

SHOREBIRD FIELD STUDY

Grade level: K - 12

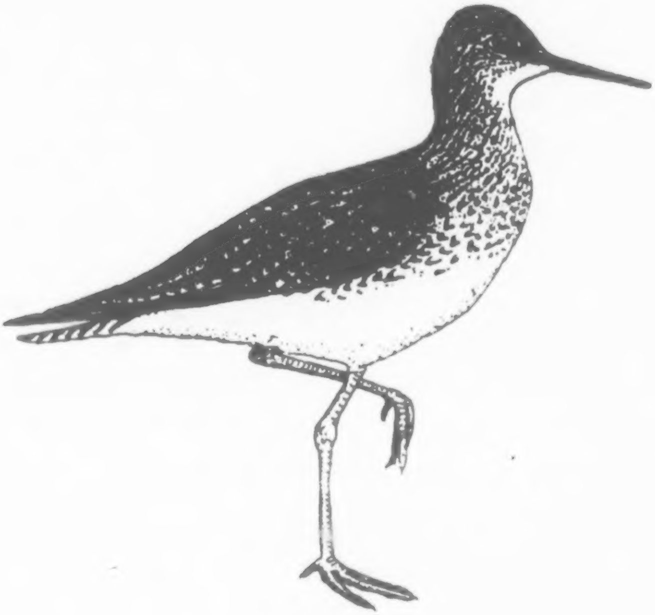
Objectives:
By assigning students tasks, they can focus on practicing making careful observations.

Materials:

Task cards, made from the masters in Appendix D in the back of this book
or
Shorebird Field Study Worksheet and Shorebird Observation Record Sheets

Procedure:
Copy and laminate task cards found in Appendix D. You may wish to make several copies of each for large classes. Assign tasks to students before trip. Several students can share the same task.

Alternatively, have students use the following worksheet to focus their activities. Review the worksheet before the field trip. Students may also use the Shorebird Observation Record Sheets which are included. See also "Data Analysis" on page 214.



- Field Trip Activity -

SHOREBIRD FIELD STUDY WORKSHEET

1. Take a quick look around the wetland. How many birds do you see? ____________________
Move a short distance away from the rest of the class and sit down where you can see most of the wetland. Sit as quietly as possible. Listen and look carefully.

2. Do you hear any sounds? Are any of these sounds bird songs or calls? Try to see the birds that are making each sound.

3. Use your binoculars (or set up a spotting scope) and scan the water and shoreline carefully. Can you see any more birds? Describe them on the Shorebird Observation Record Sheet.

4. Look closely for feathers, tracks, and places where birds have probed in the mud. Describe any signs of birds that you find.

____

____

____

____

5. Watch for the first bird that starts the flock off on a flight. Does the leadership change during the flight?

____

How quickly or slowly does feeding resume after the birds land again?

____

6. Watch a single bird that is probing the mud or sand for food. Can you tell when the bird finds food and when it doesn't?

____

How many times does the bird poke in the sand or mud before it finds something to eat?

____

7. On the back of this page, make a map of the wetlands showing where you saw the birds or signs of their presence.

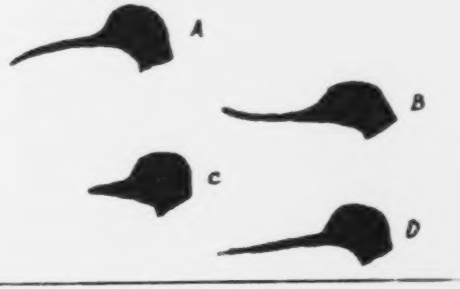
Draw your map here:

SHOREBIRD OBSERVATION RECORD SHEET 1

bird no.	no. observed	size (see below)	bill type (see below)	bill color	leg color	bird names

Size:
- A. Larger than a raven
- B. Smaller than a raven, but larger than a robin (8 inches long)
- C. Smaller than a robin, but larger than a sparrow (5 inches long)
- D. Smaller than a sparrow

Type of Bill:
- A. Curves down (*decurved*)
- B. Curves up (*recurved*)
- C. Short and stout
- D. Long and thin



SHOREBIRD OBSERVATION RECORD SHEET 2

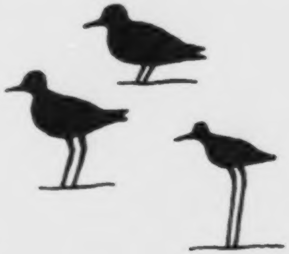
bird no.	no. observed	length of			color of		bird names
		legs	bill	tail	breast	back	

length of legs:

A. Shorter than depth of body

B. Longer than depth of body

C. Longer than length of body

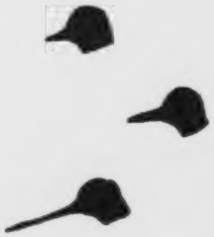


length of bill:

A. Shorter than head

B. Same length as head

C. Longer than head



tail length (standing):

A. Shorter than wings

B. Same length as wings

C. Longer than wings

CAST A TRACK

Grade level: 2 - 9

Objectives: While taking part in an enjoyable crafts activity (which can be adapted to other themes and uses), students practice skills of careful field observation and track identification.

Duration:
Time for locating and identifying wildlife tracks
35 minutes outdoors from the time of track-identification until initial cast hardens
35 minutes in classroom at a later time to make finished cast

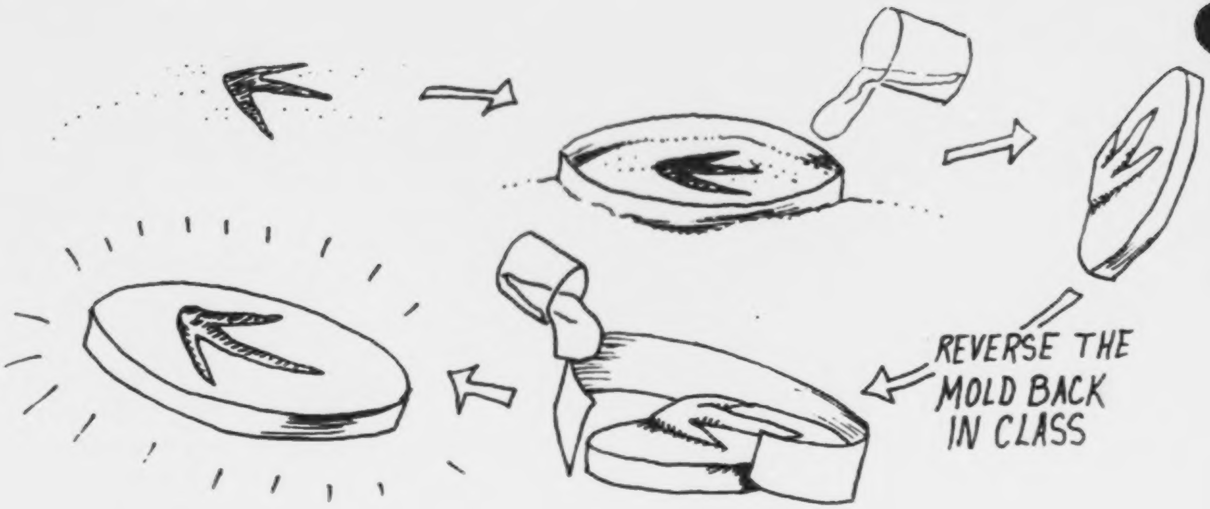
Materials:
Animal (preferably bird) tracks
1 box plaster of Paris
Fresh water (approx. 1 liter, depending on size of class)
1 empty jar
1 lightweight cardboard strip (approx. 1.5" x 10" per student)
Forceps
Toothbrush or knife

In the classroom:
Petroleum jelly
Plaster of Paris
Shellac

Procedure:

Have students follow these steps:

1. Look for bird tracks. Good places to look are areas of damp mud near ponds and streams or along the beach at low tide.
2. Draw in your notebook all wildlife tracks that you find, and try to identify the birds or animals that made them.
3. When you find a good track, carefully remove sticks and leaves from it. In snow, spray the track with fine mist and let it freeze.
4. Mix enough water with the plaster to make a thick batter. If the track is in snow, mix snow with the water before you mix up the batter. This cold batter will be less likely to melt the snow and ruin your track.
5. Press a strip of cardboard (on its edge, like a fence) into the sand, soil or snow surrounding the track.
6. Pour the batter inside on top of the track.
7. Wait until the plaster dries and hardens (about 20 minutes). Then, lift up the casting and carefully clean away dirt with a toothbrush or knife.



REVERSE THE MOLD BACK IN CLASS

8. **Back in class:** To reverse the track, coat your plaster track with petroleum jelly, then repeat the above steps as if the casting were a track. If desirable, paint the inside of your track with ink.

Extension:

Invite a local outdoorsperson or knowledgeable elder to help identify tracks, either while accompanying your field trip or with the plaster casts back in the classroom.

Adapted originally from *Wetlands & Wildlife.*

- Field Trip Activity -

MUD CREATURE STUDIES

Background:
The viewing procedure below and on the next few pages describes a water habitat. The equipment and activity can be easily modified for use in exposed mud or sand habitat, where an underwater viewer would be unnecessary and a bottom sampler would be replaced with a small shovel. For rocky intertidal habitat, simply turn rocks (remembering to carefully turn them back) for "bottom sampling," and don't forget to watch for any changes apparently caused by the rise or fall of the tide. You can also compare tidepool animals with temporarily exposed animals.

Limit the number of bottom and core samples taken for this activity, as these are very disruptive to habitat. This is especially true if the area you plan to visit receives a large number of visitors already.

For older students, have them practice their taxonomy skills by identifying the invertebrates, if not by species, then at least to a certain level in their hierarchical name classification (e.g. crustacean, amphipod).

Grade level: 4 - 12 (adaptable for younger children by modifying or skipping the use of the data sheets).

Objectives: Become aware of the life hidden in the water, mud, or wetland. Become aware of why the habitat is important to shorebirds and their ecosystem. Learn about the characteristics and organization of some invertebrate phyla. Practice skills of scientific sampling, including transect use, careful observation, and data recording. Practice skills of comparison, teamwork, care of field equipment, and drawing.

Materials:

- Meter stick
- Millimeter ruler
- String
- Paper
- Pencil
- 4 stakes
- Drawing paper
- Hand lens
- Sieve
- Bottom sampler (water) or shovel (exposed habitat)
- Core sampler
- Underwater viewer
- Invertebrate Forms 1 and 2
- "Mud Creature Study" reading
- "Marvelous Mud Meals" diagram

Procedure:

1. Have students read "Mud Creature Study" and examine the "Marvelous Mud Meals" diagrams.

2. In the field, divide students into groups (at "stations") for underwater viewing and for sampling of bottom, surface, and cores.

If enough adults are present and time allows, students can rotate from one station after another. Otherwise, let each participate in one station and then share back in class.

3. Underwater viewing: Examine the water surface carefully, and then use your underwater viewer to look under the surface. How many different kinds of invertebrates are visible?

4. Surface sampling: With stakes and string, mark out a 1-meter square area of shallow water along the wetland's edge. Move back away from this *transect* (study quadrant) for one minute.

   Are there any small animals (invertebrates) on the water surface? Take a close look at each animal. Assign each kind a number, and record the number of legs, wings, body segments, and its color, length, and type of mouth parts (if visible) on Invertebrate Form 1.

   > ***Younger students:***
   > Simplify the form, concentrating on number of legs, color, and where found.

   Draw a detailed picture of the animal on a separate piece of paper. Be sure to number the picture so it matches the right number on your Invertebrate Forms. Then list the animals by number on Invertebrate Form 2 and record the number that you found of each kind in the "surface sample" column.

5. Bottom sampling: Collect a bottom sample with the bottom sampler, and assign each new animal a number and record their characteristics on Invertebrate Form 1. Then record the numbers you found of each kind of animal on Form 2 in the "bottom sample" column.

6. Core sampling: Collect a core sample within the transect using the core sampler. Repeat the above steps, using the "core sample" column this time on Form 2.

In-Class Extension:

This is another opportunity for students to familiarize themselves with the enormous spectrum of invertebrates while practicing research and careful comparison skills. Give students copies of the "Marvelous Mudflat Meals" diagrams. Note that on one page *common names* (local, nonscientific or nonLatin names) for the species are given, while the other gives more general categories. Have students research in their textbooks or library for pictorial examples of these animals. Have them check similarities by looking carefully at the name of the animal, its shape, the number of segments, etc. Do any appear to match even though the name given in your source is different from that on the diagram? See who can come up with the most good matches.

Adapted originally from Salt Marsh Manual: An Educator's Guide, and Wetlands & Wildlife.

- Student Reading -

MUD CREATURE STUDY

Wetland areas where shorebirds stop on their migration route support an abundance of life. Some mudflats are estimated to contain 40,000 organisms per cubic inch of mud! Shorebirds depend on these organisms as food, or to feed their food items. A food pyramid can be drawn to depict the flow of energy and nutrients from salt marsh, slough, or wetland to the organisms at the top, the larger *omnivores* (such as humans) and *carnivores.*

Phytoplankton and bacteria form the bottom layer of the food pyramid. Phytoplankton are plants or other *autotrophs* (organisms that make their own food) that are too small to be seen by the naked eye. Autotrophs directly harness the sun's energy and trap it in the chemical bonds of food molecules which they put together. This is the beginning of the path that energy, or "food," takes through the lives of organisms. The "food pyramid" could just as easily be called the "energy pyramid", because gaining energy is why we eat food. Although they are tiny, the food *producers* form the largest step of the pyramid because of their large numbers and because everything above them depends on them. Simply put, there wouldn't be animals if there were no plants!

These autotrophs are eaten by *zooplankton* (microscopic animals and other *consumers* which live in water), which are in turn eaten by worms, clams, or crustaceans (like crabs, amphipods, and shrimp). Birds and fish then eat these small animals. Humans, foxes, eagles, and other large omnivores and carnivores are at the top of the food pyramid. Their step is the smallest because it takes a lot of plants and tiny animals to provide their food.

By studying the invertebrates at your site, you can get an idea of the food available to shorebirds in this habitat. An invertebrate study can also be a way to determine water quality and the health of the local ecosystem, and since shorebirds depend on feeding sites along their migration route, any damage to the health of these critical stopping sites may have an impact on the shorebird population.

Take samples of the mud, sand, or soil while you are on your field trip in order to see what the shorebirds are eating. When you get back to class, discuss the following questions:

- Which sample (layer or transect) yielded the highest total number of animals?
- Which sample provided the most different kinds (species) of animals?
- Does the type of invertebrates present tell you anything about the water quality? (For example, worms and clams may have different water quality requirements.)
- How does the number of invertebrates compare to the number of shorebirds observed? What about the number of hawks and eagles as compared to the number of shorebirds?

INVERTEBRATES FORM NO. 1: *TYPES OF INVERTEBRATES FOUND*

Date: ____________ Location Name: ____________ Student(s) Name(s): ____________

Time: __________ Time of Nearest Tide (if intertidal area): __________ (circle: high/low) Habitat Type: ____________

	Characteristics								
Animal No.	Number of Legs	Number of Wings	Number Body Segments	Describe mouth parts	Length (mm)	Color(s)	Where found	Other Info	Animal Name
1									
2									
3									
4									
5									
6									
7									
8									

INVERTEBRATES FORM NO. 2: *INVERTEBRATES FOUND USING VARIOUS SAMPLING METHODS*

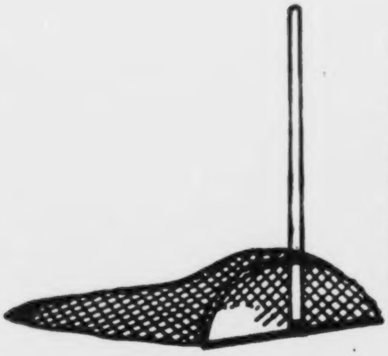
Date: ________ Location Name: ____________ Student(s) Name(s): ____________________

Time: ________ Time of Nearest Tide (if intertidal area): __________ (circle: high/low) Habitat Type: ____________

	Number of Individuals Found in Sample				
Animal No. or Name	Surface Sample or ________ Sample	Bottom Sample or ________ Sample	Core Sample or ________ Sample	Other Sample: ________	Total Number Individuals
1					
2					
3					
4					
5					
6					
7					
8					

- Field Trip Activity -

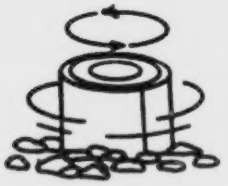
TECHNIQUES FOR VIEWING WITH SAMPLING EQUIPMENT



WHAT'S ON THE BOTTOM? - I

Materials: bottom sampler, pan or plastic bag

Place the bottom sampler on the bottom of a stream or wetland channel so it faces into the current. Gently turn over the rocks and stir the gravel and sediment in front of the net, then lift the net out of the water. Rinse the contents into a sorting tray or a plastic bag full of water and examine your catch with a hand lens. Squeeze a handful of the bottom material. Is it sand or mud or gravel? Describe its color and texture in your notebook.

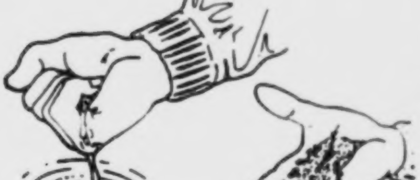


WHAT'S ON THE BOTTOM? - II

Materials: core sampler, forceps or small net, pan

Place the core sampler open end down on the stream or pond bottom and twist it down into the sediment. Put your finger over the nail hole, then pull your core sampler straight back up. When the bottom of your sampler is at the sediment surface, slip the jar lid or a flat piece of wood beneath the can, then lift it out.

Rinse the sediment in a pan, then carefully pick out the invertebrates with a pair of forceps, or small net, and place them in a plastic bag, or a jar, full of water, so you can watch them or show them to others.



WHAT'S ON THE BOTTOM? - III

Materials: bottom dredge

Squeeze a handful of the bottom material. Rub it between your fingers. Is it sand or mud or gravel? Describe its color and texture in your notebook. Collect sediment from different spots with the bottom dredge. Put the sediment in the sieve and wash it by gently swishing water through the sieve. Put the remaining debris in the bottom of a dishpan with a little water. Pick through it, watching for movement.

Source: Wetlands & Wildlife.

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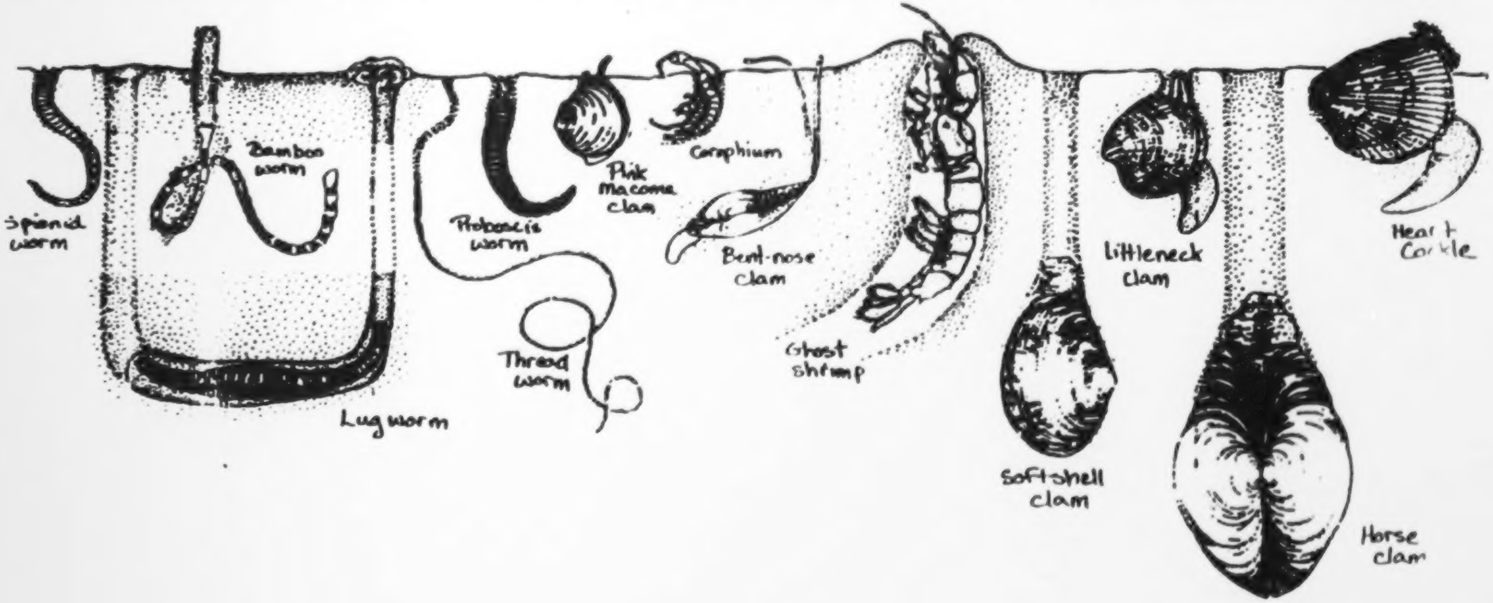
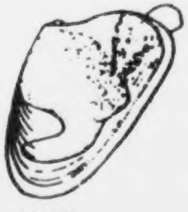
Marvellous MUDFLAT MEALS


Spionid worm
Bamboo worm
Lugworm
Proboscis worm
Thread worm
Pink Macoma clam
Corophium
Bent-nose clam
Ghost shrimp
Softshell clam
Littleneck clam
Horse clam
Heart Cockle

Source: from ***Exploring Estuaries & Wondrous Wetlands*** *– Teachers Resource Guide Supplement to "Discover Boundary Bay". More details can be obtained by writing FOBB P.O. Box 1441, Station A, Delta, B.C., Canada V4M 3YB. http://www.bcwetlands.com*

More Marvey Mud Meals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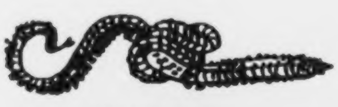
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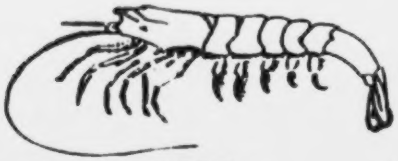
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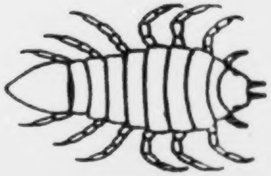
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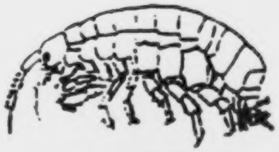
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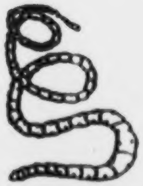
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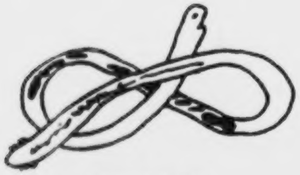
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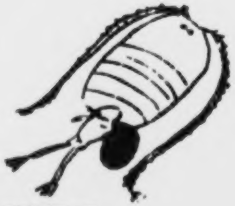
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Source: from Exploring Estuaries & Wondrous Wetlands *- Teachers Resource Guide Supplement to "Discover Boundary Bay". More details can be obtained by writing FOBB, P O. Box 1441, Station A, Delta, B C, Canada. V4M 3YB. http://www.bcwetlands.com*

- Field Trip Activity -

SAMPLING POPULATIONS IN THE FIELD

This activity requires that students can get to the shorebird viewing site on a regular basis, with or without teacher supervision. Parental involvement is encouraged, especially for younger students. It would also make a fine Science Fair project for a dedicated student.

The activity is written for a migration stop-over site, but students can make similar investigations if they live closer to a shorebird wintering or breeding habitat. It can also be modified to answer other questions about shorebirds and shorebird habitat use. *Just make sure students are sure of the question they are researching before they begin!*

This activity replicates the scientific sampling process by counting the number of birds in a small plot several times during the migration. ***Sampling*** is the scientific method of measuring one or more variables on a small plot (a ***transect***) and using those results to make assumptions about a larger area (extrapolating the levels of those variables to a larger area). Usually scientists are interested in making statistical comparisons that require that they follow a series of specific procedures under standardized conditions.

The data acquired in this activity can be used as a numerical index of how many shorebirds there are in a particular area. This can be much more instructive than saying there are "a lot" of shorebirds out there as opposed to "a whole lot" or "gazillions."

Another value of this activity involves the opportunity to make hands-on, critical thinking discoveries about the scientific process. If students are encouraged to keep close track of their data as they collect it, they may discover for themselves how important it is to collect sufficient data, and attempt on their own to make more than the minimum number of counts. Other possible discoveries include the importance of choosing an appropriately representative sample plot. Such discoveries will serve them well as responsible investigators in the future.

Grade level: 8 - 12

Objectives: Learn to develop a procedure or protocol for collecting observation data. Practice using the scientific method. Practice field research and develop responsibility for carrying out and continuing own work. Practice observation and censusing skills. Practice data recording and analysis, calculating averages, making inferences, and applying results.

Duration: Regular counts over a 2 to 4-week period

Materials: Clipboard and paper or field notebook
Graph paper or computer graphing program
Pencil
Watch

Optional: stakes and flagging tape

Procedure:
Have students follow these steps:

1. **Choose a sample plot, or *transect* area.** It should be set up in typical shorebird habitat which is used on a regular basis during the time when shorebirds are in your region. You will probably need to contact your local shorebird researcher, interpreter, or other knowledgeable person to find out the best time and place to do your sampling.

The sample plot need not be very large (25 meters is a suggested start). Remember, the birds will be moving around. An observer should be able to see and count all of the birds in the plot within 30-60 seconds.

2. **Mark boundaries:** You may or may not need to use artificial markers to define the boundaries of your plot. Natural topographic features like rocks, gravel bars, and well-defined clumps of vegetation may serve just as well. The shape of the plot does not need to be regularly geometric. The idea is to define the boundaries well enough so that you can return to and make counts in that exact same area repeatedly.

The exact place where the observer should stand will probably also need to be marked in order to produce a consistent view of the sample plot (and eliminate the variable of any bias based on a changing view).

3. **Set up counting protocol:** After setting up your sample plot, you must determine what your counting protocol will be:

Remember that you will be trying to take a numerical "snapshot" of your birds at a specific time. In order to compare the activity on your plot from one day to another, you should decide when, relative to the tide, your counts will be made and for how long. This is important to standardize because most of the shorebirds will concentrate on the beach or mud flats as they are being exposed by the receding tide. Because the time of tide is different each day, you won't be making counts at the same time each day.

Sample Protocol:
a) The period during which you will make your count every sample day is defined as the one hour following the time that the tide recedes enough to completely expose the plot.
b) During each visit, all birds present will be counted within one minute.
c) Wait three minutes after the last count is finished, then repeat the count.
d) The plot will be counted at least three times for each sample.

4. **Design a log or chart** on which to record your data. This log should include all elements of your predetermined protocol. A log for the sample protocol above would include place for the date, time of the counting period, time of each count, and number of birds counted each time. You may also want to include the time of the tide and the name of the researcher (if a team is involved) doing the counts.

5. **Carry out your counts.**

6. **Present results in table form:** From your log you can create a table of your results so that you can determine the average number of birds in your plot for each day that you counted. Remember to include complete labels explaining your tables and graphs and the *units* (e.g., dates, number of birds or days). For example, what is the table below showing? (It is showing the relationship between number of shorebirds and date at one particular location.)

Example of Table:

Number of Shorebirds Counted (All Species) at Alfred's Beach

Date	April 22	April 25	April 30	May 1	May 4
Count 1	24	55	180	95	70
Count 2	8	45	250	90	45
Count 3	35	60	200	125	56
Count 4	17	— (no count)	195	—	65
Average:	**21**	**53**	**206**	**103**	**59**

Note that the actual log used in the field would probably contain space for more data than shows in the final table of results. For instance, on each count day, you may have recorded the times of counts. Such data is important to have in your logs if you decide to look for other patterns relating behavior to the environment, and so that anyone else will be able to exactly replicate, and therefore test, your work.

7. **Present results pictorially:** Using your table of results, plot a graph of your data so that seeing any patterns will be much easier.

8. **Using your data:** Now you can start asking questions and see where it leads you! There are several ways to look at the data you collect and even more lessons to learn from it.

If other students censused other areas, compare the shape of your graph to one produced with research data for your whole area. How do the graphs compare? Why do they look the same or different? If you counted all the species separately, do all of the graphs look alike? Why, or why not? When is the peak of the migration in your area? Have you collected enough data to determine this?

Does this exercise bring up more questions than you can answer with these data? What sort of things would you have to observe or measure to answer those questions?

As you can see, the more data you can collect, the better you can answer your questions. Good luck and enjoy!

Activity originally created by Rich Kleinleder and the Shorebird Sister Schools Committee, Alaska, 1994-1995.

POST-TRIP ACTIVITIES

- Post-Trip Activity -

DUNLINS AND FOXES GAME

Grade level: 2 - 6

Objectives: Review what has been learned about shorebirds, their migration, and habitats. Practice listening and critical thinking skills.

Duration: One 15 to 25-minute class period or interval during the field trip

Materials: Large area in which students can run (if activity is carried out during the field trip, make sure not close enough to birds to disturb them!)

List of true and false statements about shorebirds

Optional: Props to go with statements (see "Teacher Preparation", below)

Teacher Preparation:

Prepare a list of true and false statements based on information your students have learned about shorebirds. Alternatively, assign students to develop these lists.

Examples:

"Some shorebirds cover thousands of miles when they migrate" (True).

"This is a picture of a Dowitcher."

"Shorebirds eat mainly plants" (False).

Procedure:

1. Divide the class into two equal teams, the Dunlins and the Foxes. Line up the two teams, facing each other, about two feet apart. About 15 feet behind each team, draw another line for Home Base.

2. The leader makes a statement about shorebirds aloud, and if the statement is true the Foxes chase the Dunlins, trying to catch them before they reach their Home Base. If the statement is false, the Dunlins chase the Foxes. Anyone tagged by a member of the opposite team must join the other team.

3. If the answer is not obvious to the players, you'll get some of the Foxes and Dunlins running towards each other, and others running to their Home Bases. During the pandemonium, the leader should remain silent and neutral. When the action has calmed down, the leader can reveal the correct answer.

Adapted originally from Cornell, Sharing Nature With Children.

- Post-Trip Activity -

SHARING CIRCLE

Grade level: 2 - 7

Objectives: Reinforce, share, and evaluate what was learned by students on their field trip. Practice reflecting, summarizing, and communication skills.

Duration: One 15 to 30-minute class period

Procedure:
Gather students in a circle and share what was experienced or observed. Have students finish the sentence "My favorite thing today was....," or "One thing I learned today was...."

Alternatively, have students record their responses on a large piece of butcher paper, or record their thoughts in a journal.

DATA ANALYSIS

Grade level: 4 - 9

Objectives: Make calculations from actual data and practice determining averages. Recognize factors influencing data collection. Practice critical thinking skills.

Duration: One 20-minute class period

Materials: Completed "Shorebird Observation Record Sheets" or "Invertebrates Forms"
or
Other data collected on field trip by several individuals or groups
or
Imaginary data in the form of a set of measurements which differ because of observer variability or bias but all measuring the same shorebird or habitat variable

Procedure:

1. During a field trip, have students collect data made about their observations. For instance, each pair of students can be responsible for collecting the information on the "Shorebird Observation Record Sheet" found in the *Field Trip Activities* section. (Two versions are included, containing two sets of information.)

2. After the field trip, combine the information collected by individuals (or groups or classes). Besides number, size, etc. of birds, averages can be calculated for water temperature, wind or water speed, or number of invertebrates.

Alternatively, invent measurements of shorebirds using the sizes given on the description sheets or in shorebird identification books as guides. For example, if a shorebird is described as between six and eight inches, ask students what the average size of a bird from an imaginary site is if five birds from the site measured 6.5, 6.75, 7.0, 7.75, and 8.0 inches.

3. Discuss why groups got different measurements or numbers. What sorts of things might have affected the measurements? For example, a) Did everyone take measurements at the same time? At the same place? Might the actual water temperature vary at different times of day, or on different days? Would weather affect the measurements? b) For numbers of birds, might the behavior of different groups of students (noisy versus quiet) have affected the visibility of animals? c) Did all the observers make the same quality measurements? Did everyone count, or did some guess? Does everyone see color or shape the same way?

Is calculating an average of several people's data the best way to determine a measurement? What else could you do to obtain an accurate measurement?

218

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TYING IT ALL TOGETHER

CONCEPTS:

- **Understand the Big Picture by Tying Together All We've Learned About Shorebirds**
- **Put What We've Learned to Use**
- **Share Information about Shorebirds**
- **Review and Assessment Suggestions**
- **Taking the Next Step to Conservation**

- Activity -

DECISION DILEMMAS

Background:
The following activities are designed to help students identify different types of human concerns as they relate to decisions affecting wildlife and wetlands, and to practice making responsible and appropriate decisions about taking action. It is not intended to designate "right" and "wrong" answers for students. In fact, students are encourage to understand that the real world is a place of many needs (conflicting and coinciding), views, and compromises based on the best and most complete information.

Teachers are encouraged to have students do additional research about each dilemma, so that decisions are based on the best factual information available. Wetland protections laws are likely to be under legislation, so it would be appropriate to discuss potential changes in class and/or have students research legislative action.

Grade level: 6 - 10

Objectives: Consider a sampling of types of human concerns as they relate to wildlife and wetlands. Examine values and beliefs related to wetlands, wildlife, and other elements of the environment. Evaluate actions and their potential impact on wildlife and the environment. Practice skills of analysis, application, discussion, evaluation, decision-making, problem-solving, synthesis, group interaction, and communication.

Duration: One 45 to 60-minute class period

Materials: Decision Dilemma cards

Key Words: dilemma, compromise, stewardship, mitigation, rights, responsibilities, Army Corps of Engineers, Environmental Protection Agency

ALTERNATIVE 1: Decision Dilemmas

Teacher Preparation:
Copy and cut up the Dilemma Cards, making enough so that each cooperative group will have a copy of each dilemma. Other dilemmas can be written that are more specific to problems in your area, or you may wish to make additional cards from the dilemmas listed in "Alternative 2," below.

Students can also be involved in creating dilemma cards, with each student responsible for one card. You may choose to have them base their dilemmas on questions raised during this unit on shorebirds, use issues found in the newspaper or in conservation journals, ask their parents for ideas, or even interview members of local agencies, commissions, Native corporations, or tribes for ideas about local "dilemmas".

Procedure:

1. Divide the class into groups of four and give each group a stack of Dilemma Cards. Place the cards face down at the center of the group.

2. The first player draws a card from the top of the stack. The player reads the situation aloud to the group (not necessary to read the "options" aloud yet), and then has two minutes to study the situation, decide what s/he would do, and formulate reasons for the decision. (The other students can contemplate the issue silently.)

3. When the allotted two minutes is up, the player reads the situation and options aloud to the rest of the group. The student gives the decision s/he has chosen and briefly describes the reasoning involved. Make sure that the student stands or otherwise takes a position of leadership so that s/he can lead the following discussion:

4. In turn, each of the other members of the group is invited to comment on the dilemma and what s/he would do in the situation. The discussion of each dilemma by the members of the group should be limited to about five minutes. The person whose dilemma is being discussed should have the opportunity to ask questions of other members of the group, and to offer clarification about his/her decision.

The discussion gives the students experience in having ideas examined by peers, and is intended to remind the student of the need to take personal responsiblity for decision-making. It is not necessary and may not be desirable for the students to reach consensus; there is a legitimate range of views of the most appropriate and responsible actions to take in many situations. The purpose is to provide students with an opportunity to think about realistic habitat conservation issues, and examine, express, clarify, and take responsibility for their own reasoning.

5. The card is then returned to the bottom of the stack and the next player selects a card from the top of the deck. Continue this process until all students have had the opportunity to express their decision and rationale about a dilemma.

ALTERNATIVE 2: Decision Dilemmas

Teacher Preparation:

1. You may choose to compose your own decision dilemmas based on local issues.

2. Obtain information from the Army Corps of Engineers and Environmental Protection Agency on their methods for making decisions about wetland use. Consider inviting a Corps or Agency representative to your classroom to explain these methods (see step 5, below).

Procedure:

1. Read one or more of the following decision dilemmas (concentrating on one at a time) to the students or adapt them to describe a wetlands-permitting dilemma in your community. Do not read aloud the possible solutions given. They are for your use in the discussion that will follow.

2. After you have read each situation, ask the students to write down what they would do and why. Encourage creative alternatives that can maintain wetland values while allowing important human activities to occur.

Decision Dilemma 1:

You own land and would like to build your home on it. You will need to place a pad of gravel on the land to provide a stable foundation for your house. You find out that it is legally classified as a wetland.

Possible answers for teacher use in discussion:

A. Find out which part of your land is used by fish or wildlife or has other wetland functions and plan your home for the area that has lower use or fewer functions.
B. Find out whether placing gravel on the wetland requires a permit.
C. Apply for a permit.
D. Build your house without getting any permits.
E. Sell your land to someone else and buy another piece of land for your home.
F. Learn as much as you can about the land which you serve as *steward* of:

    1. Ask local biologists (university, government, private industry, etc.) for information about and advice about any necessity for protection of organisms or habitat on your land.
    2. Ask the same of local land-users and Native elders.
    3. Inquire about methods of land development (e.g., boardwalks, proper drainage, alternative building materials and plans, any existing roads or structures which you can incorporate into your plans, any pilot programs of alternative construction methods or local land use which you might take part in or even have financed) which might have a lower negative impact on, or even enhance wildlife.

Decision Dilemma 2:

You are the owner of an oil company that has leased part of the North Slope of Alaska. You plan to construct a gravel pad and drill an oilwell on tundra wetlands. When you apply for a wetlands permit, you learn that the place you want to fill with gravel is very important for nesting shorebirds and waterfowl, and for feeding caribou in the summer. The gravel will destroy the habitat.

Possible answers for teacher use in discussion:

A. Study the area to find out if there is an area close by which is not as important for the birds and caribou and where drilling the well would therefore cause less harm to wildlife.
B. Find out whether it is possible to drill the well in a different location and how much more that would cost.
C. Follow you original plan and apply for permits.
D. Redesign the gravel pad to make it as small as possible (any engineering ideas?).
E. Follow your original plan but offer to improve wetland habitat somewhere else (research the concept of *mitigation*).

Decision Dilemma 3:
A plover which is endangered in your state is found to nest only on beaches which are open to recreational use of off-road vehicles (ORVs or ATVs). What few nests are built are frequently destroyed by off-road vehicles. You own a four-wheeler and like to ride on that beach.

Possible answers for teacher use in discussion:

A. Decide that many of the small, inconspicuous plovers would be protected by re-routing traffic if the public only was *informed* about their nests and habitat needs. Take the initiative to begin a public-information campaign, perhaps via the placement of signs on the beach, letters to the editor of local papers, or the internet.
B. Get involved with a committee made up of the public, users of ORVs, and wildlife-protection agencies and groups to come up with a solution that protects the plover and allows for some recreational use, perhaps by building an alternative trail.
C. Find other places to ride your four-wheeler.
D. Retire your four-wheeler from recreational use and resolve to only use for work or subsistence.
E. Disregard the issue and continue to ride on the beach with an ORV/ATV.

Decision Dilemma 4:
Some people are planning to build an asphalt plant near a wetland in your community. They are also proposing to dispose of the oily wastes which the plant would generate in the wetland because taking the wastes somewhere else would be expensive, and they may even believe that no significant harm will be done. Because the wetland is on public-owned land, a hearing is being held to hear the concerns of the community. Would you testify at the public meeting? Can you think of changes in the plan that might change your testimony?

3. After the students have written down what they would do and why, ask them to go back and think about what types of information they would like to have to help them with each decision. Urge them to consider as wide an array of information as possible.

4. Ask the students to describe what they based their decision on. (Each dilemma should elicit a variety of responses.) Discuss the spectrum of values, emphasizing to the students that different types of concerns are often raised in trying to make a decision: when a group tries to make a decision together, everyone makes their decision based on an individual set of concerns and beliefs about what they think is true about the situation. Their decisions may be altered by things they learn from others.

Ask students how they would develop a common set of beliefs about a situation (find the information through research or scientific investigation that each person needs to help make the decision). How could they solve a problem if the players do, in fact, possess different concerns which may be in conflict? Someone has to decide what the best solution is, which is often a ***compromise***.

5. Discuss the process used by the Army Corps of Engineers and Environmental Protection Agency to decide whether or not to allow an activity to occur on wetlands. (Try to provide the most current information available from these agencies.) Their decisions sometimes preserve and sometimes destroy wetlands.

To make these decisions, they consult the public and many state and federal agencies in order to get information and advice about the value of a specific wetland in relation to the value of the construction project (i.e., what types of human benefits will occur) being proposed. They then weigh and balance the concerns and benefits.

6. Consider the reasons that students gave for their decisions. Divide them into categories or lists according to the following criteria used, and consider which of the reasons given by students would be used by the Corps of Engineers to make their decision:

A. Concerns that the Army Corps of Engineers and the EPA wetland permit review teams are legally required to consider when determining the public interest in wetland protection issues:

Conservation, economics, aesthetics, environmental fish and wildlife values, flood damage prevention, welfare of the general public, historic values, recreation land use, water supply, water quality, navigation, energy needs, safety, food production.

B. Other concerns upon which people base their decisions: religious, cultural, political, social, educational, survival/physical health, scientific, personal history, personal use.

7. Have the students break into small groups of four or five and brainstorm whether or not they would issue a permit for fill of the wetland or use of ORVs in the previous dilemmas. Encourage them to list the benefits of each project to people and the detriments to people as well as the negative impacts that might occur to the wetland.

8. Note that the objective of the activity is to give students the experience of presenting and explaining their views and being allowed to question and learn about other points of view. The activity is not meant for the students to reach a concensus.

Extensions:

1. Have students consider what the result of their decisions and related actions will be in ten or twenty years. If the dilemma involved a plot of land they owned, what will not only their own land, but the neighboring land owned by others be like?

2. Have students consider the impact or importance of *public information/education* campaigns as a means of helping people make informed decisions. Students should also realize that their school education is important because it is *their* main opportunity for learning the basic biology (and science in general) of their environment. The more they learn now, the more informed their decisions will be as adults. There is never a limit to how much you should learn!

3. See "You Be The Scientist" activity for additional ideas and tips for students on formulating a study plan.

Older Students:

4. Have students do a fast-write (take out a piece of paper and write one page or for 10 minutes) on one or more of the following issues:

- Consider the rights of the landowner versus the rights or best interests of all of the people and environment of the region.
- Consider present interests versus future needs and interests.
- Consider the responsibilities of the landowner (*stewardship*) versus responsibilities of the local government for the welfare of its people and land.
- Consider the government or tribal role (in other words, a community group) versus the individual in the issue of *rights* and *responsibilities*. What forces grant you your rights or determines responsibilities for you? Are the answers different for different types of rights and responsibilites. Can they change? Under what circumstances?
- Brainstorm about what individuals, government agencies, and organized groups might reasonably be consulted about a habitat issue. What different kinds of groups own tracts of land or lease resource-extraction (mining, oil drilling, hunting, fishing, etc.) rights? What kinds of individuals or groups use the land? What kinds of individuals or groups are affected by land-use decisions?

Afterwards, have students form groups to discuss their papers.

Adapted with permission from Project WILD K-12 Activity Guide. ©1983, 1985, 1992 Council for Environmental Education, and from "Dilemma Cards", Wetlands & Wildlife. The complete Project WILD Activity Guide can be obtained by attending a Project WILD workshop. For more information, contact the Alaska Project WILD Office at 907-267-2168.

DILEMMA CARDS

You are head of a task force created to select the best course of action to attempt to preserve the Red-Speckled Goose. There are 200 birds left in a steadily declining population. Left to their own, they will probably die out. Some members of your task force would like you to authorize capturing some of the birds and sending them to zoos with expensive breeding programs to try to propogate them in captivity.

Do you:
- leave them in their natural environment?
- capture some of them for zoos?
- have another idea?

You have found a beautiful spot to build a home. One hillside of the property has a beautiful view and is your choice for your homesite. However, you discover an active Bald Eagle nest on that hillside. Bald Eagles are sensitive to high levels of noise during nesting and to loss of their nesting sites or nearby perch trees. Bald Eagles are higly selective in their choice of nest sites, and usually return to the same nest year after year. The species is protected.

Do you:
- select a different site on the property to build your home?
- sell the property? (What will happen to it?)
- chop down the trees and build your home?
- have another idea?

You are on a field trip with your class to a zoo. Although you know that the feeding of animals by zoo visitors is prohibited, some of you friends are feeding marshmallows to the bears.

Do you:
- tell them that feeding the bears may harm them and ask your friends to stop?
- report their behavior to the nearest zookeeper?
- ask the teacher to ask them to stop?
- not do anything
- have another idea?

You are a logger and live in a remote logging camp. One day, you notice a leak in the large fuel storage tanks in the camp. Oil used for heating and cooking has been leaking for some time into a small bog and stream next to the camp. When you point it out to your boss, she tells you not to report it or clean it up.

Do you:
- do what your boss tells you?
- insist the spill be cleaned up and volunteer to do it on your own time?
- report the spill anonymously to your state department of environmental conservation?
- report the spill to someone else in the company you work for who has responsibility for environmental protection?
- have another idea?

- Activity -

SHOREBIRD WAX MUSEUM

This is an excellent opportunity to have younger students learn through teaching older students about shorebirds. If possible, invite middle or high school students as well as parents to attend. Also, young students can learn by presenting their "living wax museum" to even younger children: invite preschool, kindergarten, and first-graders to attend your class's presentation.

Grade level: 2 - 5

Objectives: Learn distinguishing facts about one species of shorebird and its habitat. Share information about shorebirds with others. Practice skills of memorization, recitation, individual and whole-class presentation, and advertising.

Duration: Three 30-minute class periods for preparation, practice, and posting signs in the school
Plus possibly another 5-minute session to practice line memorization,
Plus one 45-minute class period for presentation (and preparation)

Materials:
Drawing paper
Large sheets (at least 18" x 24") of butcher block paper or newsprint
Drawing/painting supplies
String
Tape

Optional: Costume materials

Teacher Preparation:

1. Arrange a 45-minute period on a day within the next week to allow the class to present their living wax museum to the school or other classes.

Because the wax museum is a one-on-one experience this should not be an assembly, but rather simply a time during which other classes come to visit and take part. You may wish to arrange to use the gym or cafeteria if your classroom is not big or easily accessible to attendees. Tile floors or bare walls make attaching the habitat pictures easier too.

2. Advertise "The Shorebird Wax Museum" to the school and to parents ahead of time. Let teachers understand that the experience for visiting classes requires as little as 10 to 15 minutes during the advertised time frame.

Procedure:

1. Assign each student a different species of shorebird. Tell them that these are the birds that they are going to *portray*, or represent, in the Shorebird Wax Museum.

2. On sturdy sheets of drawing paper, have each student make a sign with his/her shorebird's name on it. Have them use big letters so that visitors to the wax museum will be able to identify

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the birds. Attach long pieces of string to two ends of each sign so the students can wear the signs around their necks. Provide pictures of their shorebirds and have the students draw them on their signs. (To help them with their drawings, you might have them take special note of things like how long and what color the neck, legs, and bill are, and any spots their birds have.)

3. Provide each student with a large piece of paper and tell them that this will be their *habitat*. Have them draw a big, colorful picture of where a shorebird lives.

4. Using bird guides as references, provide students with 2 - 3 sentences of information each on their shorebirds. Include information about the shorebird's habitat so that student "shorebirds" can gesture toward their "habitat" during the presentation. This is the information which they will recite in the wax museum. Allow time to help them memorize their sentences so that they can recite them easily out loud. (You might form them into pairs to practice out loud).

5. ***Optional:*** Have students brainstorm and create simple costumes or costume elements to wear when they represent their shorebirds. Suggestions: paper beaks or wings, paper breast panel of appropriate colors or streaking, paper bird bands (see "Banded Birds" activity), feathers, camouflage clothing.

6. At least a day before the presentation date, have students design and produce signs to advertise the wax museum, and let them post them around the school. Be sure that signs include the date, time, and location.

7. Also make, or have students make, a couple of signs to be posted on the door of the wax museum or other visible place. The purpose of these signs is to provide instructions to visitors: *"One at a time, touch a shorebird softly on the shoulder and listen to what he or she has to say".*

8. Present the Shorebird Wax Museum! Instructions:

- Space the student "shorebirds" evenly around the room, allowing plenty of room for visitors to pass in between.
- Have the students tape their paper "habitats" onto the floor where they will stand (let them stand on the habitat or directly in front of it), or onto the wall behind each "shorebird".
- Students don any costumes they have created to help them look like their birds.
- Students wear their identifying signs.
- "Shorebirds" stand very still and silently in place. (Try standing on one foot while you roost!)
- Teacher facilitates visitors in approaching the "living wax shorebirds": invite visitors to one at a time place a hand on a shorebird's shoulder, stand back, and listen. Repeat this with all the shorebirds.
- When a "shorebird" is touched on the shoulder, it comes to life and recites its sentences about itself. When it is done speaking, it falls silent again and stands still until the next visitor touches its shoulder (and at all times that it is not reciting).
- After visitors have left, divide the class in half, and let one half of the students be "visitors" now and learn from each other by touching the shoulders of the remaining birds. After 10 minutes, let them switch.

Extensions:

1. This is also an excellent activity for learning about other species of animals or plants!

2. Combine the Shorebird Wax Museum with a Shorebird Fair. Have the students set up their displays for the Fair, and then present their "wax museum" during the opening 30 or 40 minutes.

3. Use the information on shorebirds to make an E-mail posting to the Shorebird Sister Schools Program listserver.

Special Thanks to Carrie Fennimore, Galena City School, Galena, AK, 1996.

- Activity -

A YEAR (OR WEEK OR DAY) IN MY LIFE AS A SHOREBIRD

Grade level: 3 - 12

Objectives: Reinforce knowledge gained about shorebirds. Learn about life processes and environmental factors of life in aquatic systems. Recognize environmental problems affecting birds. Practice skills of creative writing, using resource materials, perception, and interpretation. Practice the writing process by going through the steps of brainstorming, rough draft writing, peer editing, and re-writing until an acceptable finished work is achieved.

Duration: One 30 to 45-minute class period, depending on grade level

Optional: extra time for additional steps in the writing process, as described in "extensions" below

Procedure:

Have students imagine themselves as shorebirds, then write a short story in first person ("first shorebird").

Provide specific prompts, such as asking them to discuss where they have traveled, what they have eaten, the dangers they have encountered, and who they have interacted with. They should consider their bodies (e.g., size, coloration, feathers, wings) and behavior.

The story should be based on factual information. Students can use information provided in this curriculum, by local ornithologists and elders, in books from your library, and gleaned from field trips.

On your field trip, encourage students to observe and gather information for use in their story. Ask students to use all their senses in observing the habitat so they can write about the temperature, smells, sights from different perspectives, sounds, textures of the habitat (e.g., plants, soil, air, water) and light levels that they would experience if they really were shorebirds.

Extensions:

1. **The Writing Process.** Take time to build writing skills by practicing the writing process. This means following two important rules: 1) Break the above writing project into steps, and 2) Have students rewrite their paper until the finished product is well-written to the best of the students' abilities, with good spelling, grammar, punctuation, hand-writing (or typing), and reasonable content that includes all of the information you have requested about shorebirds. The following outline works well with high school students, but can be modified for use with beginning writers.

__The steps of the Writing Process__ include:

1. Prewriting: Brainstorming, mapping, bubbling, experiencing, reading, observing
2. Writing: Drafting, getting it on paper, audiotaping, fluency, ideas
3. Revising: Sentence modeling and combining, questioning, response groups
4. Editing: *Peer editing*, proofreading, teacher feedback, correctness, grammar/ usage study
5. Final drafts: Re-writing until teacher approves
6. Publishing and Evaluation: Parent audience, class magazines and newspapers, bulletin boards, reading to an audience, pupil-made books, assessment, grading, posting on the Shorebird Sister Schools Program listserver

***Peer editing*:** Before you have made any editing marks on them, make 3 copies of each student's rough draft. Form class into cooperative groups of 4. Hand back the rough drafts and copies, so that all the members of each group have a copy of each other's stories plus their own. Instruct the members of each group to take turns reading their story aloud to the group, while their partners read along silently from the copies. The partners can ask questions about the story (plot, grammar, spelling, meaning, etc.). During and after this discussion, they edit the story with pen or pencil on their copy. Also instruct them to write on the back of the paper one positive comment about it and one constructive comment about something they would change. Let students know that they will be given a "peer editor" grade based on the careful editing that they do and the thoughtfulness of their written comments.

2. **Introduce a Dilemma.** Encourage students to consider environmental changes and dilemmas, and practice the writing process as well by rewriting their story and introducing some *realistic* crisis:

As a class, and based on knowledge gained about shorebirds during this unit, brainstorm a list of possible environmental changes or crises that could befall shorebirds, and list them on the board. Examples might be wind or snow storm during migration, loss of a critical habitat area, loss of mate or nest, flooding, or disturbance by off-road vehicles. Have the students choose one crisis and re-write their original story, this time including the crisis and some resolution (negative, positive, or otherwise). This should not be an entirely new story: encourage students to simply edit their original story by including this dilemma.

Adapted from Quinlan, __Alaska Wildlife Week__, and with special thanks to David Jaynes, University of Alaska Fairbanks, 1994.

SHOREBIRD POETRY - Activity -

Grade level: 3 - 12

Objectives: Apply recently learned scientific knowledge in a creative way. Understand ecology, undertand animals. Practice creative writing, poetry recognition, imagination, spelling.

Duration: One 30-minute class session

Materials: *Optional:* assorted pictures of shorebirds in their habitat (one per student)

Procedure:

1. "A poem is a word picture (an *image*)". Discuss this concept with students.

2. Then ask them to write a poem about shorebirds in general, a particular type of bird, or shorebird feeding, migration, or habitat. Besides these themes, an excellent prompt to use is a picture of a shorebird, particularly one in its natural habitat. Copy or cut out an assortment of pictures of shorebirds and pass out one to each student. Ask them to write a poem based on the picture.

3. Finished poems can be put on display on a bulletin board or in the Shorebird Fair. They can also be published into a class book, or you can ask your local newspaper to publish the best ones in the next week's edition. Don't forget to share your class poetry with the Shorebird Sister Schools Program!

Examples of Poetry Forms:

Poetry/Rhyme Form	Example
Haiku (pronounced Hi-koo): This is an unrhymed Japanese verse consisting of 3 lines containing 5, 7, and 5 syllables, respectively.	Sandpipers skitter Probing for tasty morsels Ah! A juicy clam
Cinquain (pronounced sin-kwan): A 5 line poem. The first line consists of 1 word, the second line 2 words, and so on until the 5th line which contains 5 words.	Flock Busy crowd Searches the shore Tiny creatures are fuel For the long journey north
Limerick: This is a light humorous rhyme consisting of 5 lines of verse. Lines 1, 2, and 5 consist of roughly 3 metrical feet while lines 3 and 4 contain 2 metrical feet. (A metrical foot consists of 2 short, not accented, syllables followed by 1 long, accented syllable). Lines 1, 2, and 5 rhyme with each other, and lines 3 and 4 rhyme together.	There once was a Dunlin named Willie, Who thought that to migrate was silly; So he stayed up in Nome. Planned to make it his home, But he left 'cause he found it too chilly.

Adapted from Quinlan, Alaska Wildlife Week.

- Activity -

CAN DO: WETLANDS!

Background:
In this activity, students identify a local situation in which they can improve the environment and help wildlife. The situation can either involve hands-on experience, like planting or litter pickup, or it may involve a political action project in which the students learn how to influence people in authority to carry out a desirable action for wildlife.

Grade level: 7 - 12

Objectives: Understand the concepts of civic responsibilities, and humans as stewards of wildlife and the environment. Identify a problem endangering wildlife or habitat on school grounds or nearby. Suggest and evaluate alternatives to either solve the problem or improve the situation. Experience success in taking constructive actions to improve the environment for people and wildlife. Describe and analyze the process. Practice skills of step-by-step planning, discussion, community service, problem-solving, and evaluation.

Duration: Long-term project (generally one semester or more)

Key Words: problem, projects, responsibility, authority, compromise, alternatives, political action

Procedure:
1. **Brainstorm about problems.** Ask the students to think of some ways to improve local areas as homes for wildlife (*habitat*).

They might find it helpful if they generate a list of activities on their school grounds or in their community that have a negative impact on wildlife. The list might include litter that poses a hazard for some kinds of wildlife; a proposed pesticide spraying that will not only kill the "pest" but perhaps affect other plants and animals; removal of plants that presently help contribute to cleaning the air, producing oxygen, and serving as food and cover for varying kinds of wildlife, etc.

> *Note:* It may also be appropriate to consider helping with habitat-improvement projects which have already been identified by the local community, or asking for community input into projects in which the class can play a significant part.

2. **Select the Problem to Tackle.** Look at the list of possible wildlife habitat problems and the suggestions for ways to improve wildlife habitat at or near the school. Ask the students to select one they think they could realistically handle and do something constructive about in the time available. If they have difficulty deciding, and reasonable support has been offered for each, the students might vote to decide. Students could also make speeches in support of the problem they want to tackle, in hopes of swaying the class vote.

Given that it is important for young people to learn that they "can do" for people, and as stewards of wildlife and the environment, use your judgment in the course of this activity to assist students in selecting a project that is realistic, constructive, and possible. If not, the students may experience an activity that contributes to their thinking that they "can't do". The major purpose of this activity is to provide students an opportunity to experience success in taking constructive actions to improve the environment for people and wildlife.

> *Note:* Encouraging parental, elder, and other community involvement can: help tackle a potentially large project; allow students to learn from other adults and be exposed to other points of view; allow students to learn through teaching others; and reinforce education as a vital community process. If adults take part, though, make sure that students are allowed to take the leadership roles and *responsibilities*, and a sense of "ownership" over their own plans, actions, and abilities. Through proper evaluation, students can learn from any failures, as they can from successes.

3. **Generate plans in groups.** Once the problem has been selected, ask the students to work alone or in small groups to begin to generate ideas for possible solutions to the problem and ways to implement the project. Each individual or small group should come up with a plan, including written descriptions and sketches (perhaps in the form of a "flow chart" with arrows indicating the order of procedure) illustrating how to accomplish the project, step by step.

4. **Present plans to each other and select one.** Have the groups present their plans to the rest of the students. Students may ask questions of the groups. Once all the plans have been presented, ask the students to select the plan that seems most: a) constructive, b) realistic, c) helpful to wildlife, and d) probable to make a lasting contribution.

5. **Select alternatives, create a time-line, and finalize steps of plan.** Have the students select one or more alternative plans, in case their first choice is not acceptable to authorities at the school or village. Also make sure that all the steps of the selections are well-considered, include *time-lines*, and are complete.

6. **Practice presenting the plan to authority figures.** Once a plan and backup alternatives have been selected, have the students select a delegation to present their proposal to the school principal or the appropriate authority. Remember to include maintenance people, grounds keepers, school board, etc. (anyone who would be physically or officially involved).

A practice session before the students and any interested parents or other groups of students would be helpful. At the practice session, the student delegation makes their presentation as they plan to do before the principal (janitor, council, board, etc.), responding to any questions from the audience that might be raised.

7. **Present the plan to authorities and obtain permission to proceed.** Have the students make an appointment to present their proposal, make the presentation, and report back to their classmates. If their plan is accepted, they should make sure they know who to contact next in order to successfully complete their project. Making sure they have all necessary permissions secured, the students should proceed to successfully accomplish their project.

8. **The Project:** Do it!

9. **Analyze the results.** Once accomplished, ask the students to analyze their results. Did things work out the way the students wanted? Were there any surprises or unforeseen problems? How might the students or plans have been any more effective?

Extension:

Document the entire process on video tape.

Examples of "Can Do" Community Projects:

- ***Adopt a stream or wetland or initiate a water quality testing program*** for a stream or wetland near your school: problem-solve reducing pollution. (For information about how to set up a monitoring program, obtain the publication Adopting a Stream or Adopting a Wetland. Contact Alaska Department of Fish and Game, Sport Fish Division, Box 240020, Juneau, Alaska, 99824.)
- ***Initiate a recycling program*** in your school to reduce the demand for mineral resources found in wildlife habitats.
- ***Develop an anti-littering campaign or cleanup day*** for local streams or wetlands.
- ***Grants*** may be available from local civic groups, government organizations, or sport fishing organizations to help you with a fish stream improvement or other wildlife ***habitat enhancement project***.

  Develop a habitat-enhancement campaign around a ***theme*** such as Arbor Day, Earth Day, or International Migratory Bird Day.
- ***Create a wetlands plan*** for the area around your school: Map wetlands, evaluate their functions (Don't forget the tiny organisms which may be easily overlooked and require intense research commitments, but form the vital base of the food pyramid), map surrounding land uses, map run-off routes, determine which wetlands should be conserved, compare this with actual community wetlands plans.
- ***Develop an information program*** (i.e., newspaper articles, posters, displays and fairs) for the community about your wetland and any problems facing it.
- ***Survey the community*** about the abundance of wildlife in local wetland areas, and their use of the wildlife. Be sure to include elders to determine how the areas and use have changed over their lifetime.
- ***Develop a wildlife calendar*** for a local wetland, interview people in the community, or make observations to find out when the different species of migratory birds return and leave, when they nest, when the water freezes over and thaws, etc.
- ***Research water use in your community***. Where does it come from? Where does it go? How is it used? Are things added to it or to sewage before discharging it back into water source? Where is pollution occurring? Have students make personal and household inventories of water use and then brainstorm ways to reduce use and pollution.

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234

- Share and Review Activity -

SHOREBIRD NEWS

Grade level: 7 - 12

Objectives: Take pride in school activities through local publicity. Learn to recognize and use standard press release format. Become familiar with the news media and the use of media. Practice writing and communication skills. Practice typing and computer layout skills. Practice using quotes.

Duration: Two 40-minute class periods

Materials: Newspaper articles for students to study and use as models
Copies of "Press Release Guidelines" student information sheet

***Optional*:** photographs taken during shorebird field trips or activities

Key Words: press release, style manual

Teacher Preparation:

Collect short newspaper articles, preferably on natural history (biological science) or resource use topics. Collect at least a couple of good news examples that can be copied for the whole class. Alternatively, collect an array that clearly represents examples of news articles, human interest stories, and editorials.

Procedure:

1. Have students read newspaper articles and try to understand how these are written differently from essays. Perhaps they can even compare and contrast *editorials*, *human interest*, and *news* stories.

2. Have your students write a press release for a school, local, or statewide paper about your class participation in the Shorebird Sister Schools Program or a field trip. Use the "Press Release Guidelines" handout on the next page.

3. Hold a contest within the class for the best format, most interesting, best punctuation, grammar, etc. Then submit the best one overall to the intended publication.

Adapted from Quinlan, Alaska Wildlife Week.

- Student Information Sheet -

PRESS RELEASE GUIDELINES

1. Lead sentence tells who, what, where, when, and why.
2. No longer than one page (double-spaced and typed).
3. The most important parts of the story go first, with less important information last. (If the article must be shortened, the last paragraphs can be cut without losing the thrust of the article.)
4. Keep aware of the difference between *fact* and *opinion* on all points.
5. Be aware of the audience you are writing for. A middle school student reading the school newspaper will have different expectations than a business person reading the city news.
6. Include accurate quotes that are properly attributed to individuals. Make sure that quotes *enhance* your article by being reliable and stating something in a fresh way, not simply repeating the same words appearing elsewhere in the article. If a quote represents an opinion, does it seem to reflect a majority or *dissenting* opinion? Either is acceptable, but the writer needs to be aware of the difference so the quote is properly placed and introduced.
7. Check your spelling and grammar!
8. A short news release accompanied by photos will have the best chance of being printed.
9. For more information on writing for newspapers, consult a writers' *style manual* such as, A Manual of Style, published by University of Chicago Press.

- Share and Review Activity -

SHOREBIRD SPEECHES AND LISTENING TESTS

Grade level: 5 - 12

Objectives: Reinforce and extend knowledge gained about shorebirds. Learn about shorebirds through sharing with others. Develop and practice communication (public speaking, listening, and interviewing) and research skills.

PART 1: Preparing and Delivering the Speech

Duration: At least two 45 to 60-minute class periods for research

Plus time for all students to present speeches

Teacher Preparation:

1. If desired, arrange a time for the class to present speeches to a lower or higher grade level, parents, a school assembly, or some other group.

2. For younger students, prepare a set of research materials (e.g., books, magazines, lists of people to call for phone interviews) for their use in preparing their speeches.

Procedure:

1. Have each student research and prepare an informative speech on some aspect of shorebirds, migration, or wetland habitat. The research can include use of class and field trip notes, library books, interviews with knowledgeable people, newspaper or magazine articles, or films.

The informative speech should provide factual information in a clear, concise manner that is easily understood by people who know little or nothing about the topic.

Consider requiring that students use graphics to help communicate and illustrate the messages of their speeches. Visual aids may include poster-sized drawings, slides, hand-outs, overhead transparencies, or use of chalkboard. Also suggest to students that they point out and spell on the board key words.

Part 2, below, will require students to also come up with and write down 3-5 questions with answers from their speeches. Having them do this *before* they give their speeches will give the speech-makers an extra opportunity to review the theme and direction of their speeches.

2. Have students present their speeches to the class or other audience. You may wish to have them practice the speeches before their own class, and then present to another audience. Be sure to put a time limit on speakers.

PART 2: The "Listening Test" Evaluation

Duration: 30 minutes during and after speeches

Procedure:

1. Have each student write down 3-5 questions and answers from his/her speech. The questions should be true/false, multiple choice, or one-word answer.

2. Allow each student to quiz classmates after speaking.

Alternatives:

A. Alternatively, the teacher can combine the quizzes (perhaps selecting the two most reasonable questions from each) by collecting each speech-maker's question and answer sheet: at the end of the activity ask each student to take out a piece of paper for recording answers, and read the questions aloud to the class. Relative scores on the test (when graded on the curve to take into account flaws in the questions or presentations) will indicate how well each student listened.

B. The "listening test" can also be used by students to determine how well they communicated. In this case, compile the questions in a single written test, and have the class take the test. Cut the completed tests up so that the 3-5 questions devised by each student are on separate strips of paper. Hand these back to the students who wrote the questions so that they may evaluate themselves. Ask each student to tally the score and answer these questions:

1. Were most people in the class able to answer the questions?
   What percent correctly answered each question?
   What percent incorrectly answered each question?

2. Did many students not answer or incorrectly answer one or more of your questions?

3. Did you provide the answer to the question(s) in your speech?

4. How could you improve your speech to better communicate the point? (For younger students, provide examples: better visual aids, repeat the information twice, separate the point out from other points of discussion, etc.)

- Share and Review Activity -

SHOREBIRDS ON DISPLAY

Grade level: 4 - 12

Objectives: Reinforce knowledge gained about shorebirds, and learn by sharing with others. Practice working cooperatively. Practice design, editing, and publishing skills.

Duration: Two or three 30 to 40-minute class periods.

Materials: Drawings, photos, and written work produced and gathered during the shorebird unit

Procedure:
As a class project, take responsibility for a display or bulletin board in your school, local shopping center, village meeting building, library, or other location. If several sites for displays are available, you might arrange a contest between classes, groups of students, or schools.

Have the class design a display to help inform the community about shorebirds in your area. You might want to include information on how many birds visit your area and which habitat they use. The display could include photographs, maps, student artwork, writing, or poetry.

Assign specific tasks to each student. One student, for instance, can use a computer to retype selected poems onto a single paper that will fit better in the limited space of the display. Other students can be in charge of trimming photos or drawings to fit; drawing new pictures, maps, or borders; or collecting artifacts for the display.

Emphasize to students that a display should have a simple message, lettering should be large and easy to read, and colors and placement of display items should be carefully planned for balance and to draw attention to the most significant parts of the display.

Adapted originally from Quinlan, Alaska Wildlife Week.

- Share and Review Activity -

SHOREBIRD FAIR

Students have had the opportunity to learn about shorebirds from a variety of types of activities focusing on many different skills. As a final project, have students gather the projects they completed during the time spent learning about shorebirds, and present them to others in the form of a school "Shorebird Fair." Include photos or ongoing video-footage of students participating in activity and field trips, and playback of any tapes students have made of shorebird calls.

Grade level: K - 12

Objectives: Learn about shorebirds through sharing and teaching others about them. By deciding on themes for arrangement and display of projects, review what has been learned about shorebirds. Practice skills of communication, design, planning, and advertising.

Duration: One 60-minute class period during which other classes and parents can visit and view the displays,
or one 90-minute evening session when parents and community members are invited to attend

Materials: Pictures of Arctic-nesting shorebirds from guidebooks or other resource materials, to be used as models for shorebird drawings
Projects completed during the shorebird unit (e.g., wetland models, habitat maps, written stories or worksheets, paper bird bands, coloring pages)
Photographs or video footage of students participating in activities or field trips
Tables
Folding, upright boards (i.e., "science fair" type) on which to pin pictures and other papers for display
Paper and drawing materials for constructing signs

Teacher Preparation:

1. Arrange a time either during school or in the evening for your fair. Arrange to use the gym, multipurpose room or library if necessary.

2. Invite parents to attend a fair put on by the students in which they present what they have studied, experienced, and learned about shorebirds. Also put a notice in the school bulletin to invite other classes and allow other teachers to prepare to attend.

Procedure.

1. **Complete the Project Line-up with Shorebird Posters:** Assign a different species of Arctic-nesting shorebird to each student. On 12" x 18" drawing paper, perhaps oriented vertically, have them each draw a poster of their shorebird for display at the fair. Each poster should include the name of the species; a large drawing of the bird; and a caption, label, or statement indicating information on its habitat (may be divided into 3 categories for nesting, migratory, and wintering).

You may also wish them to include other information such as location of breeding range, or numbers seen at a local wetland during migration or a field trip. (See also "Bird Posters" in *Nesting and Breeding Additional Activities.*)

Display these posters at the fair.

2. **Advertise the Fair:** Have students make signs to advertise the "Shorebird Fair" and its location, date, and time. Have them post the signs around the school. Students can also make invitations for their parents.

3. **Decide How to Arrange the Displays According to Themes:** Have students gather all of their shorebird work together, decide how to organize it, and display it around the room. You may choose to group projects together according to themes. Theme possibilities are endless, but can include local species, habitat, breeding information, threats, behavior (shorebird and human) versus physiology, etc..

4. **Optional Activities:**

- During the shorebird fair, have students perform their "Shorebird Wax Museum" or shorebird calls and behavioral postures (see "Wax Museum" and "Behave Yourself!" activities)
- Have students station themselves around the fair in charge of playing and narrating audio or video tape or explaining and answering questions on the various themes.
- Have students lead both adult and child fair attendees in rounds of shorebird games such as "Build a Shorebird", "What Can I Eat With This Beak?", "Behave Yourself", or "Migration Headache Game".
- Set up stations where students can help visitors make habitat models, color pictures of shorebirds, or take part in other activities to learn about shorebirds.
- Have students "band" visitors with paper bands as they pass a "banding station" set up at the fair (see "Banded Birds" activity).

- Review Activity -

WILD SPELLERS

Grade level: 2 - 6

Objectives: Reinforce and review knowledge gained about shorebirds. Practice spelling and vocabulary building, as well as team playing.

Duration: One 30-minute session

Plus time first to review vocabulary words

Materials: One set of shorebird and shorebird habitat vocabulary cards, made according to the instructions below.

Teacher Preparation:

Prepare a set of shorebird and habitat vocabulary word cards by writing each word and its definition on the same side of a separate index card. Or, hand out an index card to each student in the class and assign each student to write out a vocabulary word and its definition on his/her card.

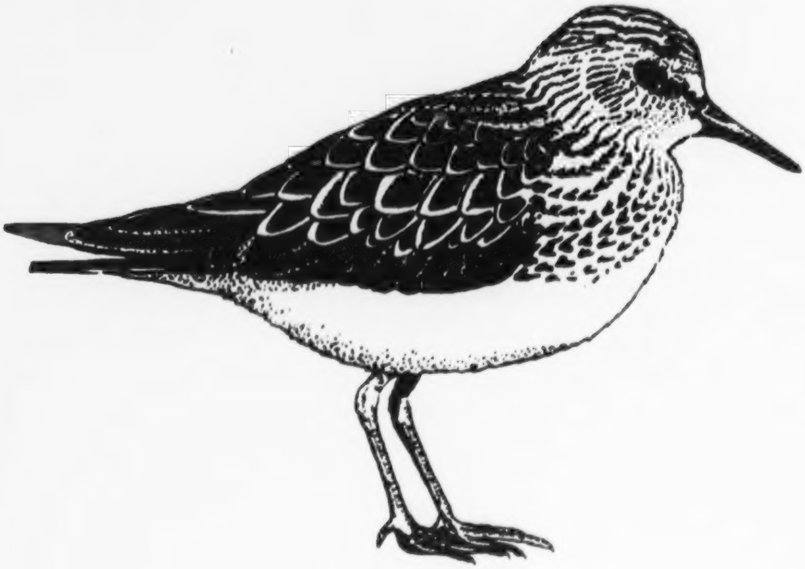
Procedure:

1. Review the vocabulary words with the students or provide time for review before playing this game.
2. Divide the class into two teams and have them line up. The teams could have names like "Dunlins" and "Sanderlings."
3. Shuffle the cards and place them in a drawing pile. Have the first Dunlin pick up a card and read out the definition.
4. Let the Sanderlings huddle to guess the word (15 second time limit). The first Sanderling in line announces their answer. If correct, the Sanderlings win one point.
5. The first Sanderling then attempts to *spell* the word. If correct, the Sanderlings win one more point. This word is placed in a discard pile.
6. The second Dunlin then picks another card and reads the new definition aloud. Each time a new card is drawn, the person at the front of each line moves to the end of the line.
7. Sanderlings guess again, with the second Sanderling anouncing the word or spelling, and so on, until an incorrect answer is given.

8. When a wrong answer is given, the first Dunlin gives the correct answer and the *last* Sanderling in line spells it out. If this spelling is correct, Sanderlings get one point. If incorrect, the teacher should give the correct spelling and place the word card at the bottom of the drawing pile.

9. The first Sanderling then draws a word card and reads the definition aloud for the Dunlins to guess.

10. The game proceeds until no word cards remain in the drawing pile. The team with the most points wins.



Adapted originally from Quinlan, Alaska Wildlife Week.

- Review Activity -

SHOREBIRD JEO-BIRD-Y

Background:

This is an enjoyable and lively sit-down activity designed to encourage reinforcement and review of knowledge gained on Arctic-nesting shorebirds. It also encourages participation by all students, cooperative communication skills, and importance and use of notes and resource materials.

You may have had your class focus on only a portion of the information included in the Arctic-Nesting Shorebirds curriculum, and have likely supplemented the information included here with knowledge from local elders, agencies, or conservation groups; gathered in the Shorebird Sister Schools Program, or on particular local species of shorebirds. Therefore, teachers are asked to complete the list of review questions included here by composing their own questions. If the class has gone on field trips, be sure and also include information gathered during the trips "in the field."

Grade level: 5 - 12

Objectives: Reinforce knowledge gained about the biology, importance, threats, and conservation of Arctic-nesting shorebirds and their habitats. Learn about importance of complete and organized note-keeping. Practice resource-using skills. Practice listening, participation, and cooperative communication skills.

Duration: One or two 45-minute class periods

Materials: List of questions and answers on Arctic-nesting shorebirds
Watch with second hand, or stopwatch

Teacher Preparation:

Compose a list of questions on shorebirds which you feel your students should now be able to answer. Incorporate appropriate questions in the list given at the end of the activity directions.

Procedure:

1. Form students in cooperative learning groups (in this case, "flocks") of three or four.

Hints when using Cooperative Learning Groups:

- Mentally compose them ahead of time.
- Vary the groups when appropriate, but keep lists of successful groupings to have handy for use again in the future.
- At the beginning of the year, allow student input and get to know your students better by passing out index cards and asking them to write down the name of any classmate that they feel they work particularly well with, and the name of a classmate (if any), that they feel they don't work well with.
- Let them know that this information is to help you teach them better, and they will certainly sometimes get to work with any preferred partners, but they are not *always* going to be grouped with whom they'd like: just as in the workplace, they might discover they do well with people they didn't expect to, and find valuable assets in these co-workers. The boss (teacher) must make the final decision.

2. Decide on the order in which the groups will take their turn. Decide, too, if you will allow students to use their notes or other resources ("open-book") during this activity. One alternative for extensive reviews is to allow notes one day and then do the activity again without allowing notes.

3. Explain the directions to students:
Tell students that you will read aloud a question on shorebirds. The first group will have 45 seconds (you may decide to allow 60) to come up with the correct answer. They must not shout out the answer, but discuss it in low voices between them so that *all* members of the group agree on an answer. When time is up, or when the group announces they have come to agreement, *the teacher* will choose one person from the group to explain the answer aloud.

The teacher announces whether Flock One's answer is correct or incorrect. If it is correct, Flock One gets a point. (The play then proceeds to Flock Two, which similarly has 45 seconds to answer the *next* question). If Flock One's answer is incorrect, Flock Two has 30 seconds to come up with the correct answer to the same question. If they are correct, they earn a point. If Flock Two cannot come up with the correct answer either, then Flock Three has 10 seconds to earn the point by answering the question. If Flock Three is incorrect, start over by giving Flock Four 45 seconds to answer a new question.

> ***Hints:***
> The teacher *always* selects the student to answer. Randomize the order in which members of a flock are chosen to answer. This will ensure that all of the members of the group are cooperating with each other, looking for the answer, or teaching each other the answer.
>
> Encourage critical thinking skills by scrambling the order of questions of different subject matter. Mix simple questions with questions which require more complex answers.
>
> When you read the question out loud, write any key words up on the board.

4. Proceed until a predetermined, set finish time, or you may be faced with groups demanding more questions (and that's good too, especially if knowledge reinforcement, not scores, are the actual goal) so that they can get ahead with their scores.

Shorebird Jeo-Bird-Y Questions (Choose among these and adapt as appropriate, do not expect to get through a large number of these questions in one class period):

1. Describe one important fact about the place where the ocean meets the land.
   Answ: 1. Contains great diversity of life
   2. Faces powerful natural forces:
      wind, waves, currents, erosion
   3. Life there must adapt to the twice-daily tide:
      The tide changes the shore from a relatively cool underwater or wet environment to a dry area of more concentrated saltiness (high *salinity*) that must endure the sun's warm rays. Alternatively, rain or river flow at low tide can cause the salinity levels to drop *below* that of the ocean.

2. Describe two important physical adaptations of shorebirds (what identifies a bird as a shorebird?)
   Answ: 1. Long legs for walking and wading
   2. Specialized bill for collecting particular food items
   3. Long, pointed wings for rapid, long-distance flying
   4. Long toes for support in walking
   5. Camouflage plumage
   6. Erect posture (most)

3. What kind of wings do most shorebirds have?
   Answ: Relatively long and pointed (although oystercatchers have relatively broad, rounded wings)

4. What type of habitat are most shorebirds found in?
   Answ: Open habitat, and often wetlands

5. Name one natural environmental cycle that is important to shorebirds:
   Answ: 1. Seasons
   2. Tides (those that are found on the shore at some time of their lives)

6. What do Europeans call shorebirds?
   Answ: Waders

7. Within 10 species, how many species of shorebirds are known in the world?
   Answ: 214

8. How many species of shorebirds regularly occur in Alaska?
   Answ: 39

9. To what does the term "Holarctic" refer?
   Answ: The geographic region made up of the North American Arctic (Nearctic) and Northern European and Russian Arctic (Palearctic) combined

10. What does "morphology" mean?
    Answ: Shape, size, color, and other characteristics that describe what an organism looks like (Generally *morphology* refers to external traits, while *anatomy* refers to either internal *or* external structure and appearance.)

11. Name three predators of shorebirds in North America.
Answ: Eagles, hawks, gulls, ravens, foxes. Small mammals like weasels, river otters, and ground squirrels may take eggs.

12. Describe two behavioral adaptations of shorebirds.
Answ:
1. Form large flocks during migration
2. Migrate long distances between wintering and breeding habitat.
3. Elaborate, ritualized displays associated with courtship and breeding
4. Some form *leks*
5. May roost on one leg

13. What does "roost" mean?
Answ: verb - rest or sleep
noun - group of resting birds, or place where they flock to rest

14. What is the purpose of roosting on one leg?
Answ:
1. Like tucking the bill under the feathers, this conserves body heat in their open habitat
2. Rest the other leg

15. Describe two things to look for when attempting to identify the species of a shorebird.
Answ:
1. The size
2. The color, any patches, or any spots or streaks on breast
3. Length, curvature, and color of bill
4. Leg color
5. Presence of any wing stripes or tail pattern
6. Feeding behavior (e.g., picking, prying, run and stop to probe, steadily probing like a sewing machine needle)
7. Any particular call notes heard as bird takes off in flight?

16. What three habitats are shorebirds dependent on each year?
Answ:
1. Breeding or nesting
2. Migratory stop-overs
3. Nonbreeding or wintering

17. What habitat do most shorebirds spend the most time in?
Answ: Nonbreeding

18. Do any shorebirds depend on more than three habitats in a year, and if so, what are the others?
Answ: Yes, they often depend on several migratory stop-over sites in the spring and in the fall, and they may be different ones in the different seasons.

19. Do all Arctic-nesting shorebirds migrate?
Answ: Yes, because ice and snow blankets the Arctic in the winter months. However, some species of other shorebirds, like Common Snipe and Black Oystercatcher, do remain in the southern parts of Alaska and Canada over the winter.

20. Name three places that Arctic-nesting shorebirds might be found during our winter months.
Answ: Many possible answers, including Lower 48 states, Hawaii, South Pacific Islands, Central and South American countries.

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21. Describe one reason why shorebirds are important to humans today.

Answ: 1. Because they are relatively large, visible organisms which are near the top of the food pyramid, shorebirds are good *indicator species* for wetland health.

2. Guano (droppings) returns nutrients to the environment.
Note: Speculate on why this isn't necessarily true for human waste (e.g., large population produces a large amount of waste and it is not concentrated like bird waste, eat non-nutritious foods, may carry disease).

3. People enjoy seeing shorebirds, whether discovering a lone one on a quiet walk or experiencing an awesome migratory flock.

4. Shorebirds as predators of some organisms and prey for others are a natural part of the food/energy pyramid, and have their own unique place in the balance of nature and our local wetland ecosystems.

22. Describe an example of what an *indicator species* can tell us:

Answ: Examples are endless, and need be only general. Look for answers which show an understanding that all organisms are affected by certain changes in *other organisms* (or *abiotic factors* such as water) in their *environment*. They may be affected through their food chain or by changes, such as pollution, in their habitat. Any change in condition or numbers of the indicator species may indicate that, for example:

1. other shorebirds in the same place in the food chain may be expected to be similarly affected.
2. other shorebirds using the same habitat may be similarly affected.
3. other organisms feeding on the same prey may be similarly affected.
4. other organisms using the same habitat may be in jeopardy too.
5. something is wrong with shorebird prey items.
6. a necessary habitat has been disturbed or destroyed.
7. water quality or amount (as with droughts, floods, and damming) has been altered.

23. Describe the Western Sandpiper.

Answ: Answers may refer to size, coloration, behavioral characteristics, habitat use, global range, or factors covered in class. Look for answers that show recognition of the species, and distinguish this species, or whichever one you choose to ask about, from others.

24. In what part of the world does the Black-bellied Plover nest?

Answ: The coast of the Arctic Ocean and Bering Sea

25. Give or take 5 days, how long are Dunlin eggs incubated?

Answ: 22 days

26. Name three organisms that shorebirds feed on.

Answ: worms, insects, tiny clams, shrimp, ghost shrimp, isopods, amphipods, spiders, beetles, and numerous other invertebrates

27. Name two shorebird prey items found on the Arctic tundra:

Answ: adult and larval insects (like craneflies), midges, beetles, spiders, mosquitoes

28. Name one species in which the female seldom raises the chicks:
Answ: Phalaropes (any of the three species), Dowitchers (either species), several species of sandpiper (e.g., Least, Spotted, Purple)

29. What is the lower back of a shorebird's head (or yours!) called?
Answ: *nape*

30. Where is the *flank* on a shorebird?
Answ: side, under wing, and towards the tail (posterior half)

31. What does *diversity* mean?
Answ: having many species or many individuals (also generally implies that the number of these individuals will include a variety of traits, types)

32. Explain how *adaptations* develop.
Answ: All organisms have a certain (set of genes that describe a) set of traits. Sometimes an individual is born with a trait which differs slightly (a mutation) from others of its species. If that different trait gives the individual an advantage in surviving to breed, it may pass on the genes for that trait. The trait may then persist in the species as long as it gives individuals that have it an advantage, or at least the ability to successfully compete and breed. The helpful traits are called adaptations because they help an organism compete to survive long enough to successfully breed.

33. Describe one type of shorebird bill and how it works.
Answ:
1. Long tweezer-like bill for probing deep below the surface of water or the ground
2. Short tweezer-like bill for probing right underneath the surface
3. Long curved bills for sweeping through the water (American Avocet) or probing into the burrows of worms and clams (curlews)
4. Relatively short bills for picking up prey items on the surface (plovers) or snatching flying insects and hopping amphipods (Sanderlings)
5. Relatively short, sturdy bills for flipping over rocks to search for prey (turnstones)
6. Large, heavy "clothespin" bill for prying limpets up and mussels open (oystercatchers)

34. Describe one physiological adaptation which helps shorebirds make long, strenuous migrations.
Answ:
1. Efficient "fat-loading" (the conversion of food into a useful source of energy)
2. Efficient burning of calories (burning few calories per kilometer)

35. What are three characteristics that define "habitat"?
Answ: A place where organisms are adapted to find:
1. Food
2. Water
3. Protection from environmental elements or a place to breed

36. Describe two things that an adult shorebird needs in its breeding habitat
Answ:
1. Food
2. A mate
3. Safe place to nest and raise young

37. Describe two things that a shorebird depends on finding in its migratory stop-overs.
Answ: 1. Rest from the long flight
2. Food for the body to convert into energy for the long flight
3. Freedom from disturbance so that it can get all the food and rest it needs

38. Describe two things that a shorebird depends on finding in its nonbreeding habitat.
Answ: 1. Food
2. Rest
3. Weather (warm or temperate, as opposed to the freezing temperatures of the Arctic during these months)

39. Why are wetlands important shorebird habitat?
Answ: Abundant, available, nutrient-rich food (prey items and vegetation thrive in areas enriched by shallow water)

41. Describe two sources of the water in wetlands.
Answ: rivers, streams, springs, ocean tides, permafrost allowing melting snow or rain water to pool at surface, etc.

42. Describe three types of wetlands that shorebirds use.
Answ: 1. ocean beach
2. mudflat
3. freshwater marsh
4. saltwater marsh
5. tundra
6. intertidal zone
7. stream/river corridors (estuaries)
8. muskeg

43. Explain three threats to wetland habitat.
Answ: 1. Drained for development or transformation into cropland
2. Water diverted or dammed for agriculture (crop irrigation), power source, drinking water, sewage treatment, use in industry, or recreation (artificial lakes or waterways)
3. Pollution from agricultural chemical runoff, and runoff through storm drains from streets
4. Accidental oil (especially in coastal habitats) or other chemical spills
5. Accidental or purposeful introduction of non-native ("exotic") species, some of which out-compete and overtake native (natural and local) species that are vital members of the food chain

44. Explain one reason why the Arctic is such a good breeding habitat for shorebirds (and waterfowl)?
Answ: 1. Billions of insects hatch there each summer and are available as prey
2. Less competition for resources and relatively lower diversity of predators (the animals with which shorebirds share their environment in the winter are left behind in the south when shorebirds migrate)
3. Long daylight hours and low Arctic sun warm nests on the open tundra
4. Besides insects, tundra provides vegetation such as berries for food

45. What is the usual number of eggs ("*clutch* size") laid by small shorebirds?
Answ: four

46. What is the major purpose of the elaborate displays shorebirds take part in early in the mating season?
Answ: Attract a mate

47. Describe two methods of brood protection.
Answ:
1. Nests, eggs, chicks, and brooding parent on the nest all have *cryptic coloration* (camouflage)
2. Distraction displays by the parent (e.g., feigning injury such as a broken wing or tail; pretending to be an easily caught mammalian prey, like a little mouse)

48. Describe one type of shorebird territory, or one common reason why shorebirds defend a territory.
Answ:
1. Mating territory (e.g., a place for a male to breed with females, or to build a nest)
2. Feeding territory, or home range, where an individual defends his/her prey-hunting area

49. Describe the mating behavior of phalaropes.
Answ: Phalaropes have a type of polygamy known as *polyandry*, in which the female attracts the male to her territory, may mate with more than one male, and leaves the male to raise the chicks.

50. What is a typical shorebird nest like, and what is it called?
Answ: It is called a *scrape*, and is a shallow, inconspicuous nest located on the ground.

51. Name three important migration stop-over sites on the Pacific Flyway.
Answ: (See your shorebird migration map)

52. What is the most serious threat to shorebirds?
Answ: Loss of habitat.

53. Why are shorebirds so vulnerable during migration?
Answ:
1. They concentrate in huge numbers, often a high percentage of the population of certain species, at their migratory stop-over sites:
    - A. They traditionally use the same sites each year, and if a vital estuary is destroyed, they will not find or stop at an alternative site (even if one is available), but fly on to the next traditional stop. They do not have the energy necessary to do this.
    - B. A single storm (which can easily occur in the spring as the weather is just turning) can wipe out large numbers.
    - C. A disturbance or oil spill when a large flock is present can kill many birds.
    - D. Wetlands are being degraded and destroyed, and populations of migratory birds are therefore under more pressure each year.

54. Why do shorebirds migrate?
Answ:
1. To take advantage of abundant source of invertebrate food items and less competition in the Arctic
2. Historically, probably developed as the ice from the last Ice Age receded

55. Explain why we often see much larger flocks of shorebirds migrating in the spring than in the fall.

Answ: The three following reasons are all part of the answer:

1. In the spring, the shorebirds are in a hurry to take advantage of the short Arctic summers (they need to find a mate, lay eggs, and raise chicks to fledgling stage before the weather turns colder and supply of invertebrate prey dies off).
2. In the spring, the shorebirds are also in a hurry to arrive on the breeding grounds at about the same time as the rest of their species so that they have a good chance of finding a mate. Some species also need to establish good territories before all are taken.
3. The fall migration is staggered into different categories. In the fall there are young birds and they take more time to prepare for migration. Parents leave early. Adults which failed at nesting or raising chicks may leave even earlier.

Getting started on supplementary questions:

1. Describe (other shorebird species discussed in class or encountered on field trips).
2. What kind of nest does a (species) make?
3. What is the source of the water in (a local wetland)?
4. Think about which shorebirds are most closely related and what features they share. Ask questions about vocabulary words listed in the "Keywords" sections.
5. Have students compare or contrast between two species, two mating systems, two wetland habitat types, or breeding and nonbreeding habitats.

252

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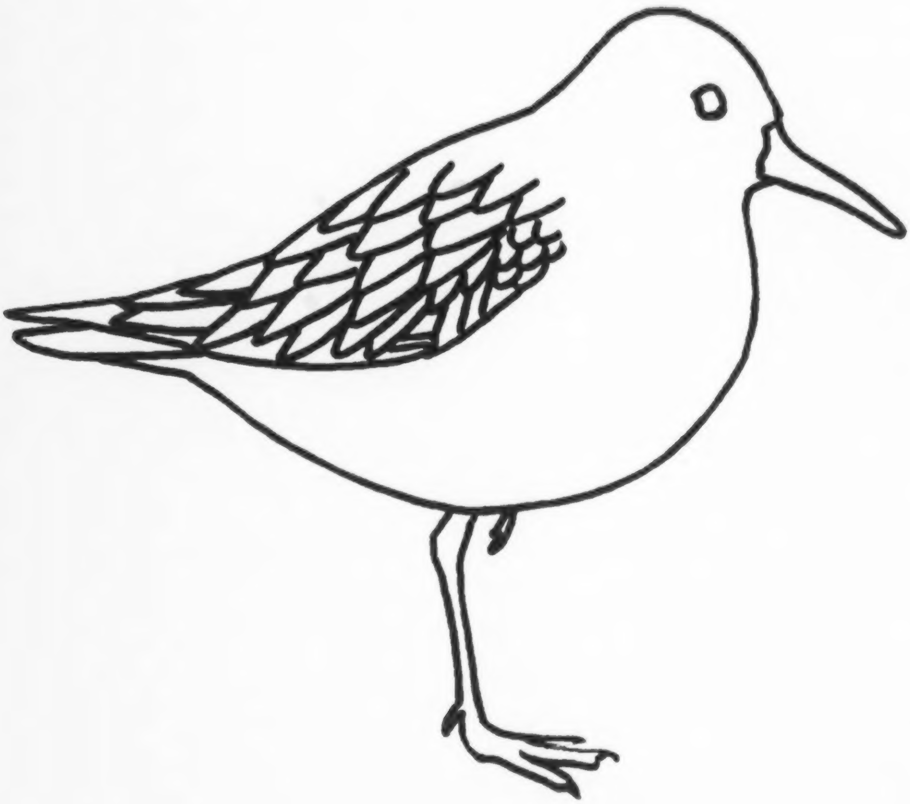
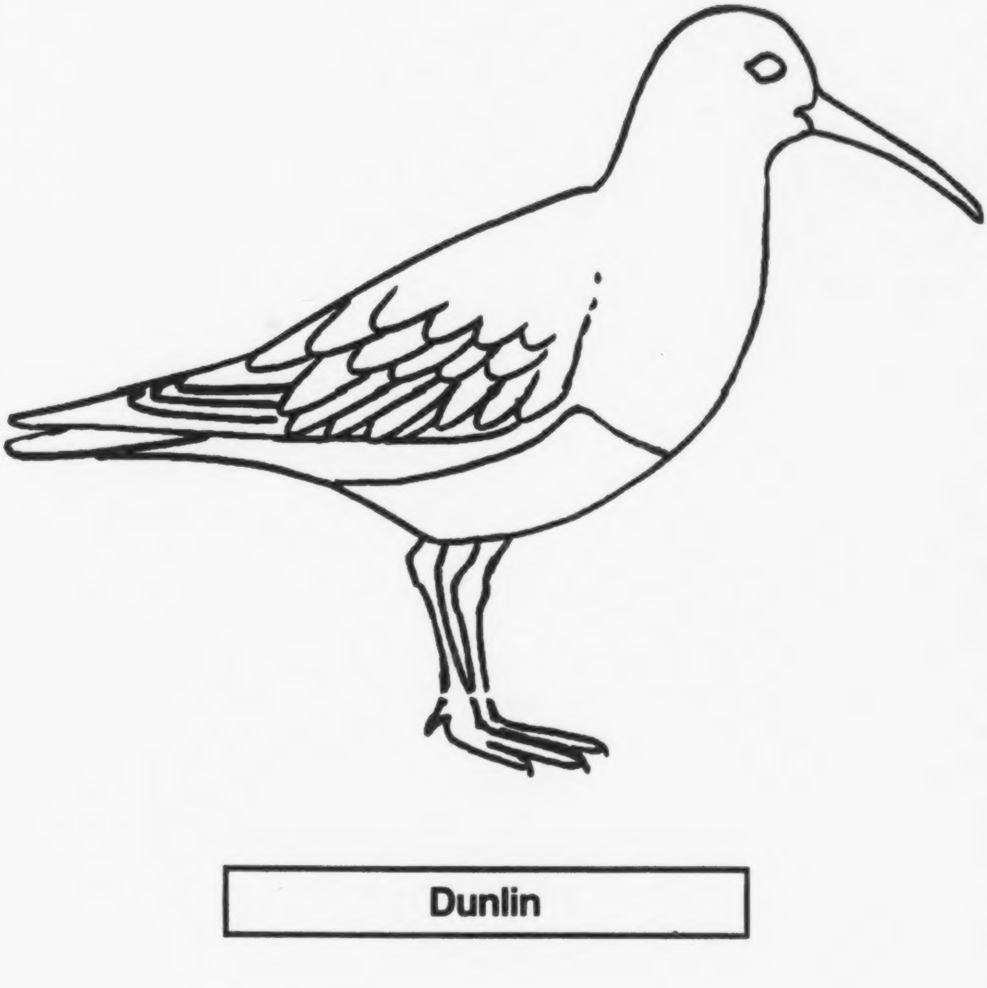
APPENDICES

APPENDIX A

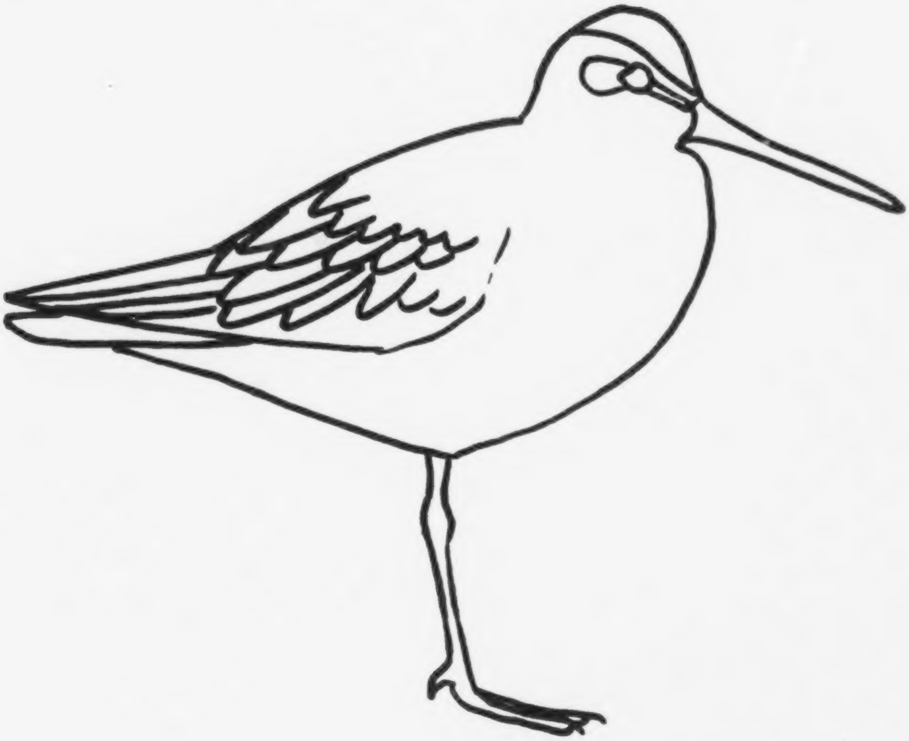
SHOREBIRD COLORING PAGES



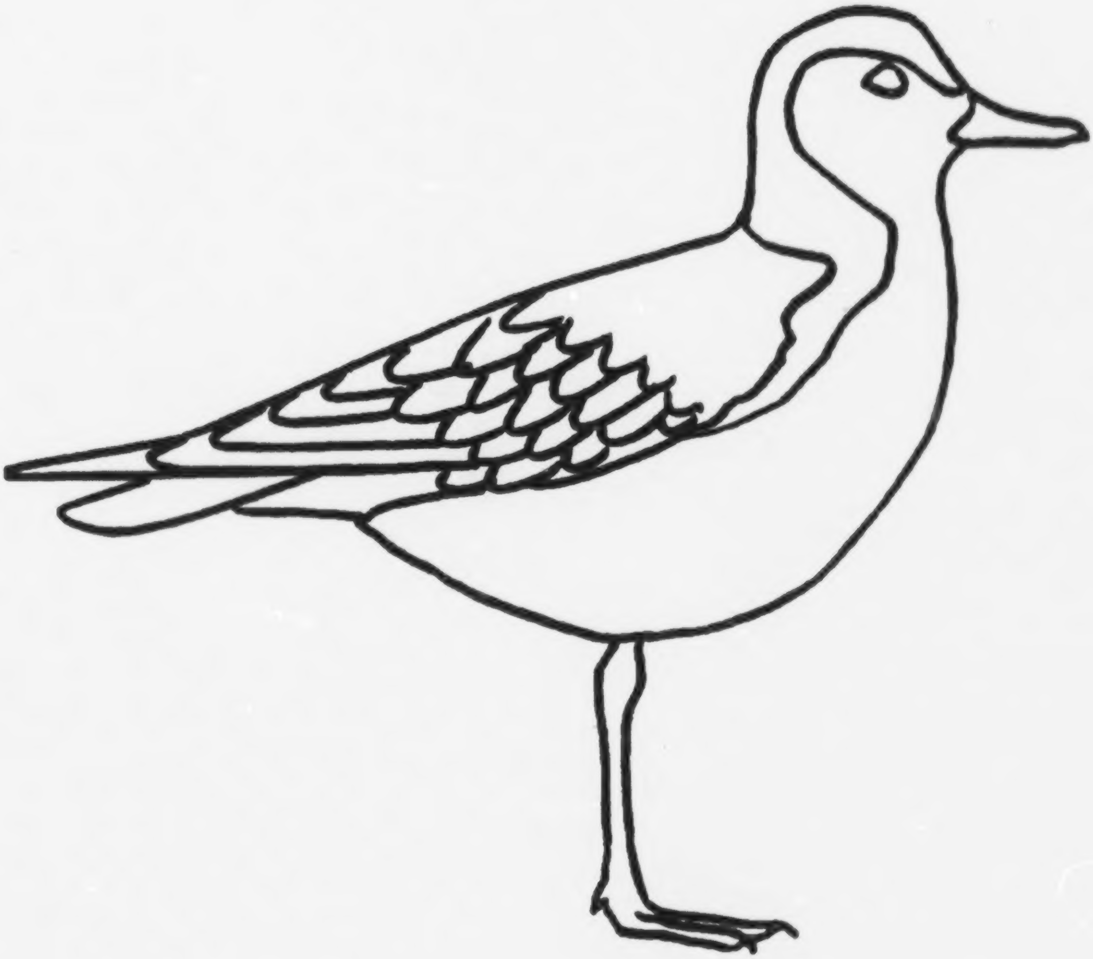
Western Sandpiper



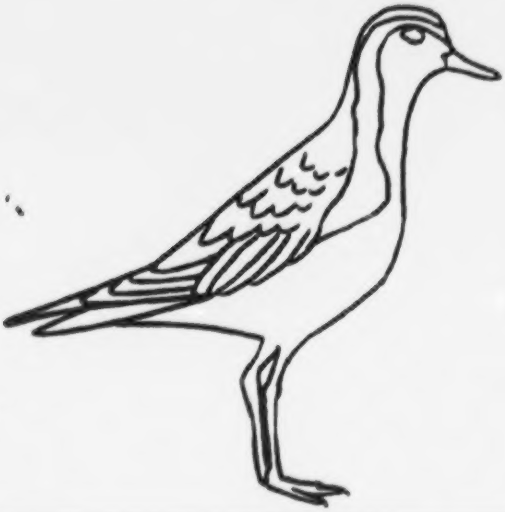
Dunlin



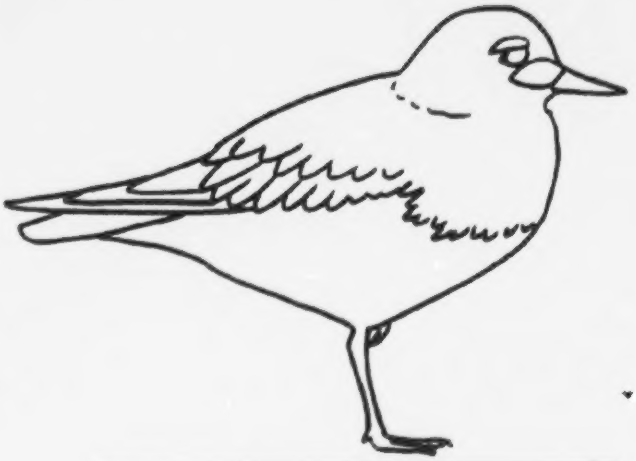
Dowitcher



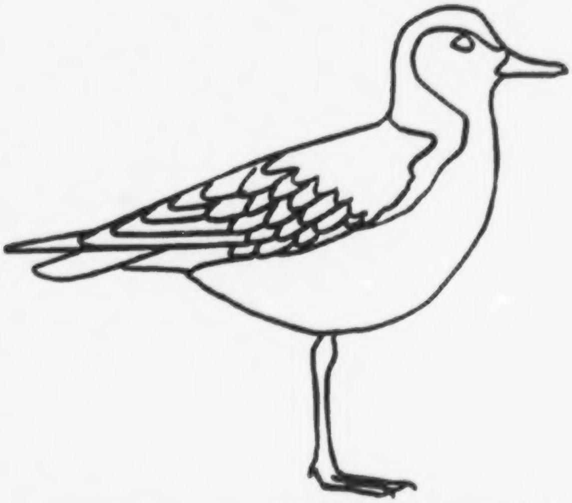
Black-bellied Plover



American Golden Plover



Black Turnstone



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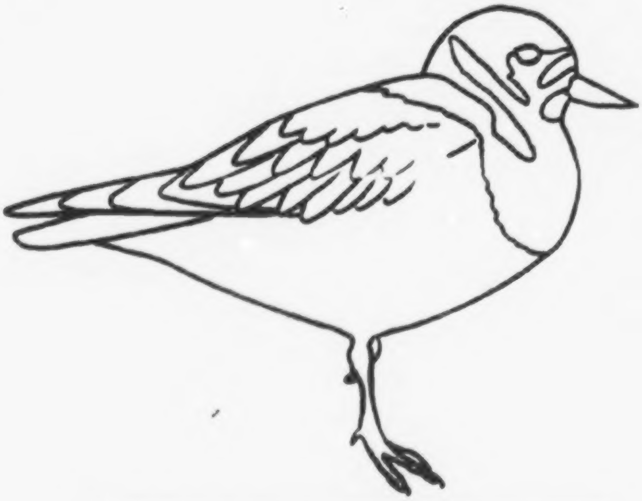
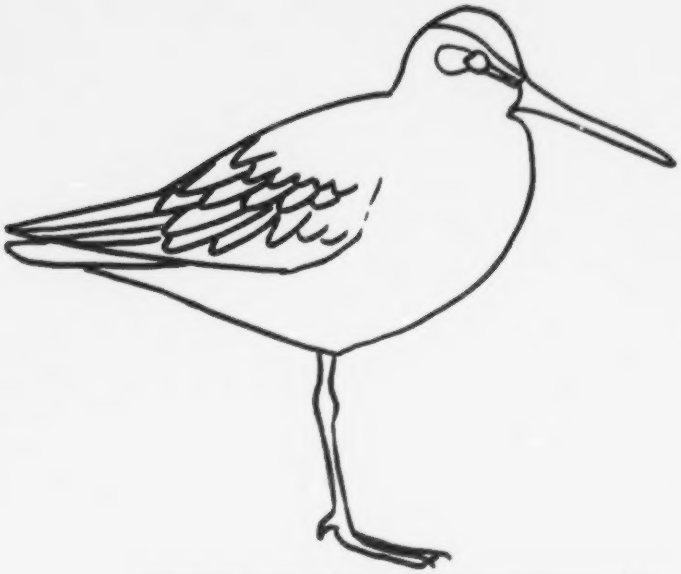
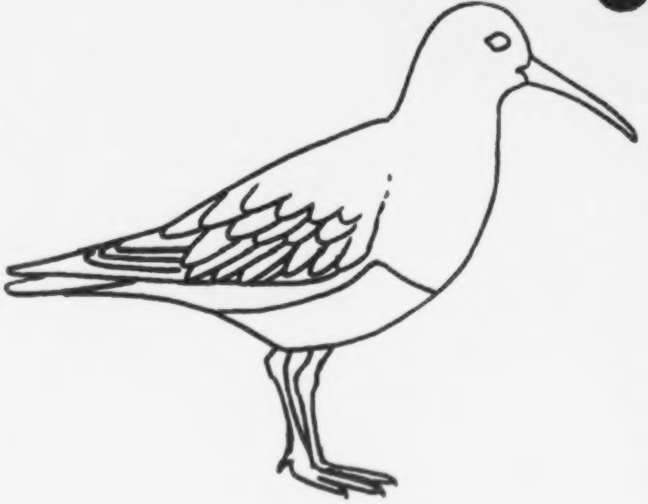


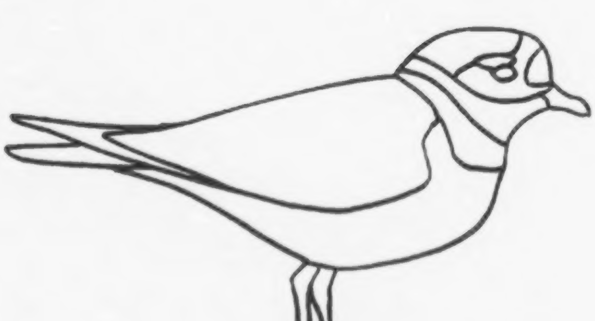
Ruddy Turnstone



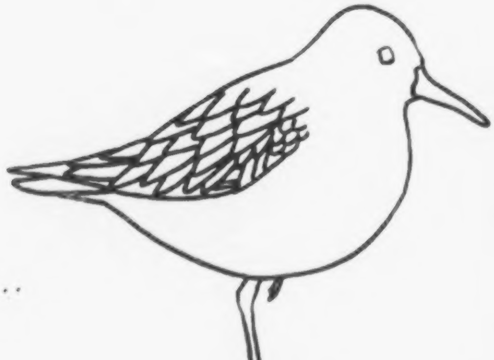
Short-billed Dowitcher



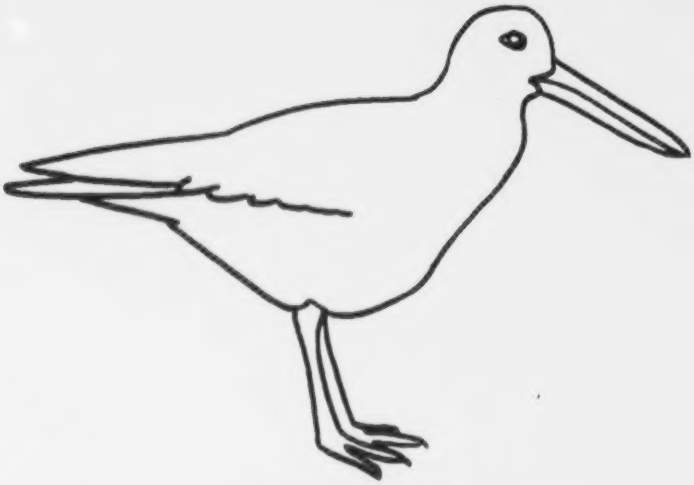
Dunlin



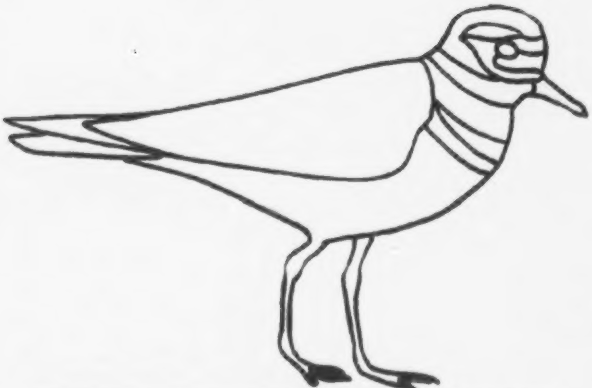
Semipalmated Plover



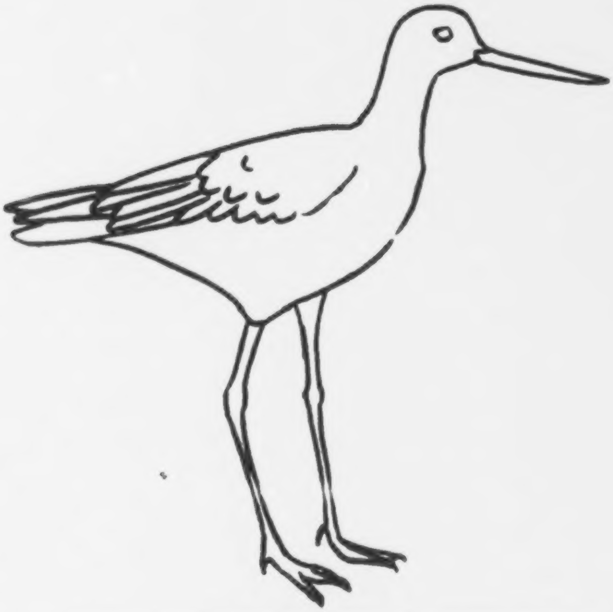
Western Sandpiper



Black Oystercatcher



Killdeer



Greater Yellowlegs

APPENDIX B

"BUILD A SHOREBIRD" CARDS

down
feathers

These are the fluffy under-feathers for insulation (the bird's underwear).

contour feathers

Strong outer feathers are used for flight. These are also the bird's clothes and coloration.

hollow bones

These help a bird keep its weight low so it can fly.

air sacs

A lot of oxygen is needed to give birds energy to fly. Air sacs extend from the lungs, between and into hollow bones. They help maximize the absorption of oxygen.

long, pointed wings

To fly fast and far, having long pointed wings is helpful.

camouflage
plumage

Camouflage, or cryptic coloration, helps birds to be less visible because they blend in with their background.

long toes

Shorebirds need long toes for stability and for walking on the mud.

long legs

Long legs help shorebirds wade through the mud and water to find food.

bill

Bills or beaks are used for picking up food, nest construction, courtship, preening and defense.

oil gland

The oil gland, found near the base of the tail, helps keep a shorebird's feathers waterproof.

guano

Shorebird scat, or guano, contributes to the chain of life. Nutrients from guano are returned to the wetlands and are used by tiny plants.

habitat destruction

Changing or developing wetland habitats can destroy animals and plants which provide food and shelter for shorebirds.

oil
contamination

Oil spills can kill shorebirds and destroy habitats for many years.

disturbance

Planes, boats and people approaching can disturb shorebirds while they are feeding or on their nests.

trash

Trash can be mistaken for food by birds and can kill them. Shorebirds can get caught in fishing line, 6-pack rings and old fish netting.

APPENDIX C

NESTING AND BREEDING ADVANCED INFORMATION READING

with accompanying
STUDENT WORKSHEET
and
ADDITIONAL ACTIVITIES

NESTING AND BREEDING

Shorebirds, like most vertebrates, breed only during one particular time of the year. Shorebird breeding also incorporates a ritual of behavior. Most breeding behaviors occur within the ***"breeding season"*** and on the ***"breeding grounds"*** (place where the species breeds). Arctic-nesting shorebirds must migrate north to these areas. Breeding behaviors there include establishing a territory, attracting a mate, courtship displaying, copulating, nest-building, laying and incubating eggs, and rearing young, but not necessarily all in that order! If a shorebird population is going to continue to exist, all of these activities must be accomplished within the two short months of the Arctic summer.

GROUND NESTS

Many people commonly think of birds as nesting in trees or shrubs, and of course many birds do. What happens, however, where there are no trees, or if a bird's feet are modified more for walking than perching? What other reasons can you think of for nesting on the ground? (One theory is that birds evolutionarily shifted to nesting on protected cliffs when the diversity of mammals and their predatory abilities increased.) Besides, trees aren't the only good way to support, protect, or conceal a nest! Most shorebirds build their nests on the ground in wetland habitat. Remember that most shorebird habitat is open space (without shading trees), and this is true of their nesting habitat as well as migratory and nonbreeding habitat. How then, are their nests protected from predators?

Shorebirds try to conceal their nests. The nest appears to blend in with the tundra, grass, or gravel. This is because it is not bulky, and is often lined with leaves, grass, or stems from the surrounding landscape. It is generally a shallow, simple-looking nest, formed as a saucer-shaped depression on the ground. The beach-nesting Black Oystercatcher constructs a simple ***"scrape,"*** no more than a concave collection of pebbles and perhaps a few shells. It is nearly impossible to see, even when standing directly above it, because it blends in so well with the expanse of gravel or rocky shore around it. Some species of shorebirds hide their nests under low shrubbery. The Western Sandpiper, for instance, may build a nest under the cover of dwarf birches in its Arctic tundra breeding habitat. Additionally, incubating parents have camouflaged plumage (cryptic coloration) and sit very still on the nest. Larger species like Whimbrel may not bother to conceal their nests.

Shorebirds also protect their eggs and young with ***distraction displays*** (see below). The parent purposely draws the attention of an intruder by calls or exaggerated gestures. Oystercatchers, some *Calidris* sandpipers, and plover parents will drag a wing along the ground, pretending that they have an injury, in hopes that the intruder will chase them rather than attack the helpless chicks. Chicks, in turn, are adapted to freeze in place when the parent makes a certain alarm call. This is a behavior designed to avoid detection of chicks by potential predators.

Why do shorebirds build their nests in wetlands? Wetlands make wonderful nursery habitat for many animals. This is because of the abundance of food, shelter, and water available there: food is in the form of plankton, plants, and - important for shorebirds - invertebrates. The leaves, blades, and roots of diverse wetland plants provide plenty of *substrate* (something on which to cling or walk) and shelter for tiny invertebrates, as well as concealment for baby birds.

Water is necessary not only for drinking and for transportation of swimming organisms, but for the development and buoyant support of all eggs and embryonic animal life. Birds have adapted to their developing young's need for water by surrounding them in a protective eggshell which keeps moisture in. The corresponding adaptation in mammals is the *placenta*, held inside the mother's body. However, tiny invertebrates (which are at the base of the food chain of many birds and mammals) provide their developing water-permeable eggs and larva with water by laying them directly in the water. Because of the richness of invertebrate life, you might think of the water in wetlands as a hearty soup to nourish young fish, birds, and mammals raised there.

VARIETY OF MATING SYSTEMS

Some shorebirds begin breeding in their second year of life (their first complete summer), but many larger ones don't become sexually mature until they are two, three, or even four years old.

Shorebirds are known for using the largest variety of mating systems among all the orders of birds. Different shorebird species use different mating systems, but there is, as with many of the other traits we've discussed, also variation among individuals and populations (we are here using "population" to mean a group of one species of shorebirds).

What do we mean by ***mating system***? It refers to the number of partners (mates) that an individual breeds with, and what kind of social bond (short-term, long-term, helping rear the young or not, etc.) it forms with these mates. There are a variety of different possible mating systems among birds, and shorebirds are adapted to use many of them. These adaptations depend on historical and ecological factors, many of which are still not fully understood.

Monogamy

Many shorebirds are ***monogamous*** for the length of one breeding season. This means that each summer a female only mates with one male, and that male only mates with one female. The next summer, they will likely find different mates. Dunlins, Western Sandpipers, turnstones, yellowlegs, dowitchers, godwits and Red Knots are usually monogamous.

Why is monogamy such a popular mating system in shorebirds? One reason is because the chicks' survival chances will be increased when there are two parents protecting a nest.

Why, then, have other mating systems also evolved? Once again, many ecological and evolutionary factors are involved. Whenever asking the question "why?" in biology, it is very important to keep in mind *the fundamental ways that natural selection* operates: if an adaptation increases likelihood of survival of an organism's genes, that adaptation's chance of being carried on (appearing in later generations) is increased.

Some shorebirds exhibit long-term monogamy. This means they breed with the same individual, and no other, in more than one year. Banded-bird studies (which enable researchers to observe an individual bird over time, without getting it mixed up with other birds) have shown that oystercatchers, for instance, may maintain the same ***pair bond*** for two years or even for life.

Polygamy

Other shorebirds are ***polygamous***. This means that an individual breeds with more than one other mate during a given breeding season. Polygamy can be divided into two basic types:

Polyandry refers to one female forming pair-bonds with two or more males within one summer. The Red-necked and Red Phalarope are two species of Arctic-nesting shorebirds which are famous for this unusual behavior. The females of these non-territorial little birds are also more brightly colored than the males, and the females are the ones to attract the opposite sex with special calls, flights and postures.

Most Sanderlings exhibit monogamy, but some individuals will mate with polyandrous behavior. The male initiates mate attraction display, but the female selects another mate after the first clutch is laid. Remember, shorebirds have adapted a big variety of behaviors!

Polygyny is the type of polygamy in which one male maintains pair-bonds with at least two females in a summer. White-rumped Sandpiper males are polygynous, defending more than one female (and nest) on their Arctic tundra breeding territories.

Promiscuity and Lekking

Shorebirds can also be ***promiscuous***. Notice that polygamy implies some type of bond that lasted beyond the actually ***copulation*** (physical union of female and male). Examples of such a pair bond would be helping to incubate the eggs, feeding the mate who is incubating, and feeding or otherwise tending to the chicks. Promiscuous individuals, on the other hand, copulate with more than one mate, but generally don't stick around to help raise the family. Female snipe are promiscuous at the beginning of the season, but when the nest site is chosen she forms a pair-bond with one male for the rest of the season.

In shorebirds, as well as birds like grouse, promiscuity often involves ***leks***. Leks are places where a group of males gather to make vigourous displays. These displays are designed to attract females for the purpose of mating, and this type of behavior is called ***lekking***. Leks occur at specific sites which are traditionally returned to year after year. What would the advantage to that be? (increases chances of quickly finding mates.) Anywhere from two to 15 male Buff-breasted Sandpipers gather on broad upland tundra leks every year. They engage in rituals of wing-stretching, waving and jumping, as females gather. Imagine seeing the strange gathering: glinting, white underwings waving in the low, bright light of an Arctic dawn. Researchers believe the sandpipers choose to display at the time of day when their wings are most showy.

ELABORATE AND RITUALIZED DISPLAYS

A ***ritual*** is a set of behaviors or activities which are performed in a particular way for a [illegible] reason or occasion. A ritual may be as simple as always arranging food on your plate the same way to suit yourself, or as elaborate as a church wedding. Members of a society respond and recognize certain rituals and often come to expect them to be repeated and performed the same way every time the occasion repeats. What kinds of rituals do you or your family take part in?

Shorebirds have evolved some of the most elaborate and complex displays associated with breeding seen among all the orders of birds. Each step of the process of breeding is associated with interesting adaptive behaviors. These displays involve repeated, exaggerated movements and postures designed to draw attention to the gesturing bird.

While you are considering the following behavioral adaptations, think about what morphological adaptations may help shorebirds carry out the behaviors.

Mate-Attraction Displays

Upon arriving at the breeding grounds, males advertise themselves or the territory they have staked out around themselves. Their attempts to attract females may include dramatic aerial and ground displays and calls. Dunlin and Western Sandpiper males perform rituals of flight displays and song. The roles are reversed in polyandrous species like the phalaropes.

For many species, displays include wing fluttering, tail cocking, nest scraping, and other rituals. On the Arctic tundra, the male Pectoral Sandpiper draws attention to his fitness as a mate by an amazing pumping of a fat-filled breast sac, accompanied by exaggerated ***gestures***, loud hooting, and low-level flights. The same ritual is repeated by all breeding male Pectoral Sandpipers every year.

One of the most hauntingly familiar cries of the North American spring is the "winnowing" or "bleating" of the Common Snipe. Near open bogs, a musical wailing sound may seem to mysteriously come from the sky. Because our eyes have difficulty focusing on the three-dimensional vastness of the sky, we may not at first see the male Snipe's strange ritual. He repeatedly flies high into the sky and then plunges straight down toward the earth before beating his wings to rise again. While doing this, his tail is held at such an angle, and the stiff feathers of it so constructed, that air rushing over the feathers produces the unique mating call. Be sure and listen for it this summer!

Courtship Rituals

Once the male shorebird is successful in his advertising display, the receptive female joins him in ***courtship*** rituals. These are gestures and activities performed between the chosen mates, and generally lead to copulation. The female responds with bows, tail movements, calls, or the way she holds her bill. Behaviors of the courting couple may include neck preening and calls. Each shorebird species has its own peculiar ritual.

The courting ritual also involves nest building. In some shorebird species the female selects the nest site, in others the male. Some shorebird pairs build the nest together, sometimes with separate tasks (like selecting, building, and lining). Many shorebirds build several scrapes before selecting one in which to actually lay the eggs.

Distraction Displays

Nesting shorebirds "might be aggressive in displays, but more often they feign injury, exhaustion, or illness to divert the predator from the nest or the young" (Ehrlich et al., p.115).

A distraction technique common to shorebird parents is the broken-wing act. A parent bird pretends its wing or tail is broken by spreading it out and dragging it along the ground. This is meant to attract the attention of a threatening intruder by appearing to be a desirable, easy-to-catch prey item. The intent is to draw a predator's attention away from the helpless eggs or chicks.

These clever *distraction displays* can also involve mimicking some other prey item. For instance, the "tundra-nesting Purple Sandpiper [parent] drags its wings (creating the illusion of a second pair of legs), erects its feathers (providing some resemblance to fur), and 'squeals' while it dodges between imaginary barriers", just as a running mouse would do (Ehrlich et al., p.115).

OTHER IMPORTANT BEHAVIORAL ADAPTATIONS

Territoriality

Mating Territories

Although a population of shorebirds may nest in the same habitat, most are not colonial breeders like seabirds. Instead, shorebirds behave ***territorially*** on the breeding grounds. The male stakes out an area for his female-attracting displays and chases out intruding males of the same species. Like most territorial vertebrates when faced with such an intruder, a territorial shorebird may direct a particular variety of displays (very different from those it uses to attract a female) toward the intruder before resorting to a chase or fight. What are the advantages of such displays over actual contact and fighting?

(Note that *territoriality* often refers to a behavior between members of the same species, or *conspecifics*. What do you think happens when a member of one shorebird species enters a different species' territory? What about other birds besides shorebirds? Would size of the intruder or the size of any threat affect behavior? [Maybe.])

Nesting Territories

The female may or may not, depending on the species, build the nest within the male's mate-attracting territory. If she does, then the breeding territory is both a mating and a nesting territory. In other cases, particularly where the males are ***promiscuous*** (mate with more than one female), it's more likely that the females will choose their own nest sites. Why might the females of some species prefer to actually nest apart from the male's display territory? (Protection from displaying males, finding a site better suited to nest-protection than mate-attracting, etc. Think about advertisement versus camouflage.)

Territory Size and Factors Affecting Size

The *breeding* territory may include a *feeding* territory, but often the breeding territory does not include sufficient food for the family. The primary purpose of a breeding territory is for mate attraction and, often, a protected nest site. Territories may be small or large, depending on the individual, the species, and the food availability. Western Sandpipers defend tiny territories, when they do have territories, while Dunlins may each defend over a dozen acres!

Think about factors affecting *territory size* in general. Why would some species regularly have small territories and others large territories? Why might a population of Western Sandpipers have small territories, while a population breeding elsewhere not defend breeding territories at all? (Indeed, large numbers of Western Sandpipers nest close together on the tundra in what are basically breeding colonies.) What might geographic *location* have to do with it? Often one of the most significant factors influencing territory size is *food availability*. Predation, number of competitive males and other factors can also be important.

Food availability is, in turn, affected by a variety of factors. Some of those factors are *seasonal availability* or general *temporal predictability* (whether or not an animal can at any time in the day or season "count on" finding food in a particular site), "*patchiness*" (evenly distributed food versus food found in patches surrounded by areas of scarce or no food), numbers of predators and competitors, and a variety of other factors. For many animals including shorebirds which defend feeding territories, territories exist or are larger when food is scarce and unpredictable. Conversely, when food is abundant and predictable, territories are often smaller or nonexistent.

This is only a guideline, not a "hard and fast" rule: when there are so many *variables* involved, no guideline is accurate all of the time.

Another factor that may affect breeding territoriality is *predation*. In the Arctic tundra summers, predators of shorebird eggs and chicks include foxes, weasels, ravens, and larger seabirds such as gulls and jaegers. A cluster or colony of shorebird nests, once found, could be easily wiped out by one such predator. These ground nests are much easier to reach than a seabird colony on a cliff. Such predators are especially common around a nutrient and water-rich marsh area, such as around a pond or slough. When camouflaged shorebird nests are spaced relatively far apart in separate territories, a predator will have to work much harder, and probably not have as good luck, finding as many nests. (As you learned in "Field Trip Etiquette" [p. 181], a scent trail left by a curious human can give a predator an unnatural advantage.)

Nonbreeding Territories

Are shorebirds territorial during the rest of the year? Some species do defend ***home ranges*** (the specific area that a shorebird normally uses, particularly to find food, during its day or nonbreeding season). The same home range may be returned to each day and defended by the same individual throughout most of the season.

Alternatively, some feeding territories are *mobile*. This means that as the bird forages along the beach, it maintains a certain distance around itself where other birds of the same species aren't permitted to forage. The individual may use different areas, but insists on defending a certain amount of space wherever it is.

Sometimes, this behavior seems to vary among individuals of the same species: some Sanderlings, for instance, are found defending the same lengthy section of beach each day, some maintain a small territory of only a meter or so, while others defend whatever area they happen to feed in that day, and many more don't defend territories at all. Sanderlings in a flock on the beach may all look alike to us, but actually they are all unique individuals.

Defense of feeding territories, just as defense of breeding sites, involves a very *ritualized* (meaning consistent and predictable) set of display behaviors. Individuals will react to intruders by cocking the tail, marching, hunching the back, or running with a certain posture. These displays *escalate* in a predictable order and only evolve to chasing and, finally, potentially dangerous fighting if absolutely necessary.

There is much more to be discovered about territoriality, like the extent which territoriality is displayed by female nonbreeding shorebirds. Biologists are still studying the territorial behaviors of nonbreeding shorebirds, but in general, shorebirds are much more aggressively territorial during the breeding season.

Why Visual and Vocal Displays?

When behaviors are sufficiently attention-getting and are repeated over time, they can aid in *communication*. This is because the rituals become recognized and understood by all members of a society. A *society* is a population which has evolved a set of rules or guidelines to help the members function and continue to persist as a group, and this can't be done without communication.

It's easy to see the benefits of "showing off" when one is trying to attract a mate. What about the benefits of using gestures or calls for defense and protection? Well, remember to consider the theories of *natural selection*. You could say that shorebirds use visual displays simply because they hit on something that works (is effective): evolution selects the *fit* individuals, meaning those that survive long enough in a particular environment to pass on their genes. If displaying as a means of defense allows a bird to pass on its genes, or at least doesn't let the bird be out-competed, a trait for such behavior may be passed on.

Why are displays effective? As with many territorial vertebrates, such gestures precede a possible escalation to actual fighting. Visual displays permit the birds to communicate their ownership and intent-to-defend without the *risk* of physical injury. As to potential predators, shorebirds are relatively small birds, and can't effectively *fight* large predators off, and young and eggs can't fly. Their means of defense instead are distraction by the parent (who can protect itself by flight) and forms of camouflage or concealment.

Multi-Clutch versus Single Clutch

In general, birds who breed where the summers are short (in high latitudes, either north or south, on the globe) only have time to successfully raise one *clutch* of eggs (eggs laid one right after the other in the same nest). The Junco pair in your yard who lost its eggs to a squirrel, or the warbler who lost its mate to a cat, may try and nest again. This is called *renesting*. In much of Alaska and Canada, however, it is unlikely that the second songbird brood will have the time needed to *fledge* before the abundant summer insect crop dies back, the weather turns cold, or the parents must migrate. "Fledge" means become able to independently fly from the nest and survive on its own. Many shorebirds probably attempt to renest if their first eggs are lost soon after laying.

Despite the short summer, shorebirds have adapted ways to sometimes raise more than one clutch of eggs to the *fledgling* stage. Some species lay two clutches, the first cared for by the female, the second by the male of the pair. In other species, such as the polyandrous Red Phalarope, one female may lay two different clutches, fathered and tended by two different males.

Parental Roles Can Vary

Care of the eggs or *brood* (young chicks still under the protection of parents) are handled in different ways by different species. The female Bar-tailed Godwit incubates the eggs by day, the male by night. These roles are reversed in Dunlins. The female Black-bellied Plover deserts the chicks when they are only half-way to fledging, leaving the male to care for them. The Common Snipe pair divides its brood up and each parent cares for only some of the chicks. Chicks from unrelated groups of Least Sandpiper nests are moved to communal feeding grounds.

Care of the Young Ends

Length of care of the young varies among species. Oystercatchers (which are not high Arctic breeders constrained by weather) may feed their chicks for more than 100 days after hatching. In some species, one parent or another leaves the family before the young even fledge. In most shorebird species, the adults leave the breeding grounds and begin their fall migration before the chicks migrate a week or two later. Imagine if this week every kindergartener in your school had to find his or her way to Nicaragua without any parents or other adults! What would they need to find their destination safely?

Migration and Breeding Site Fidelity

Shorebird migrations provide us with one of the most visually spectacular displays of nature. Many shorebirds undertake long and arduous migrations to reach appropriate breeding grounds. For each population, these breeding grounds must be the same ones used traditionally year after year. Shorebirds are said to be very ***site-faithful*** because they return to the same breeding grounds, and sometimes the same territory. Oystercatchers will even use the same scrape.

IMPORTANCE OF THE ARCTIC TUNDRA

About one-third of the world's 214 shorebird species breed in the Nearctic and Palearctic. As we have mentioned before, the Arctic tundra, muskegs, and marshes provide sheltering and nutrient-rich wetland habitat. The unshaded low plants and nests found there among the tussocks are warmed by the low Arctic sun. One of the most obvious advantages that the Arctic tundra offers are the billions of insects that are hatched there each summer and available as shorebird prey. Growing chicks need a constant source of nourishment, and the insects provide this.

The tundra provides other resources as well. For instance, the summer diet of Ruddy Turnstones (which forage for invertebrates on open shores in the winter) may include a lot of berries and other tundra vegetation.

(For information on the breeding habitats of shorebird species, see Appendix E.)

SUMMER IS THE SEASON FOR BREEDING

In the activities, we often use the terms "summer" and "breeding season" interchangeably, and the same is true for "winter" and "nonbreeding season". Let's examine those terms for a minute. "Summer" refers to that time of year when our part of the globe is tilted closest to the sun, receiving the most hours of sunlight each day, right? There wouldn't be any *seasons* if the Earth wasn't tilted on its axis, (although the equator would still be warmer than the poles because it's closer to the sun).

When those of us in the north are experiencing winter (because our part of the globe is tipped away from the sun), our migrating shorebirds have flown south. We say that the birds are "wintering" in the south, now that their breeding is completed for the year. However, if those birds are spending their nonbreeding season south of the equator, as many do, it isn't "winter" where they are, is it? December and January, for instance, are summer months, not winter months, if you are south of the equator. Our winter months are the nonbreeding season of Arctic-nesting shorebirds, but they aren't spending them in the cold! Of course, not all animals breed in the summer. When do moose mate and have their young?

The summer is very short in the Arctic, and so breeding must take place efficiently and quickly. Having a common language or a set list of tasks helps factory workers get their jobs done more efficiently than they would if everyone ran around trying to do things their own way without recognition of other people or conditions. Similarly, using a system or ritual of behaviors helps the shorebird populations accomplish mating and raising chicks in the precious time that they have available.

MANY VARIABLES affect Shorebird Breeding Behaviors

Have you noticed the number of times nonspecific terms like "many", "generally", or "often" appear in this essay? Remember, shorebirds, like all living organisms on Earth, are inexorably linked with the living and nonliving components of their local habitat or general environment. Both the individual and the environment are capable of change.

There is also variation *between* individuals and, of course, between species. There is some diversity in the morphological (body shape, structure, and color) and physiological (bodily functions) traits of different species of shorebirds. The third category of traits, behavioral traits, is especially variable. "Variable", in this case, means both that behaviors come in a great variety, and *also* means that they are affected by a great variety of factors.

You saw, for instance, that the shorebird repertoire of vocal and gestural displays is impressively large and varied. The same visual display can also be used for a variety of purposes. However, it can vary somewhat according to the *individual* (as well as sex, age, breeding condition, etc.) and the *environmental context* (time of day, time of season, weather, open vs. closed habitat, distance of bird from others, etc.) (Ehrlich, et al., p. 141). A variety of behaviors and specialized uses of the habitat also enables a diversity of species to co-exist in the same habitat.

Breeding is perhaps the most fundamental function of life. Breeding behaviors in shorebirds vary according to many factors. Factors affecting breeding behaviors can include length of migration, location of breeding grounds, food availability, type of predation, and access to mates. There may be differences between individuals as well.

Breeding behaviors can vary in such basics as degree of concealment and type of nest (camouflaged or not, etc.), mate attraction and courtship displays, methods of chick protection, degree and type of territoriality, and mating system. These variables, as well as numerous smaller ones, can be combined in an endless number of ways. Besides establishing behaviors, a shorebird must be able to face the daily threats of its environment, like predation and weather. Whew! If you woke up one morning as a Dunlin, would you know what to do to pass on your genes successfully?

- Activity -

NESTING AND BREEDING: *STUDENT WORKSHEET*

Directions: Answer the following questions based on the "Nesting and Breeding" reading.

GROUND NESTS:

1. Describe two reasons why shorebirds nest on the ground.

2. Describe two ways that shorebirds have adapted to protect their nests. Are these behaviors? What morphological (physical) traits do shorebirds need, if any, to accomplish this protection?

3. Why do so many shorebirds nest in wetlands?

MATING SYSTEMS:

1. Describe two types of polygamy.

2. What is a "pair bond"? Do polygamous birds form pair bonds? Explain.

3. Compare and contrast monogamy and promiscuity in shorebirds.

4. Why does "lekking" imply that the birds are promiscuous?

5. Describe two mating systems that Sanderlings may use. Which is most common?

6. Which is the most common mating system among shorebirds?

VISUAL DISPLAYS AND OTHER BEHAVIORAL ADAPTATIONS:

1. Why is it important that breeding grounds aren't disturbed?

2. Why do males display (before copulation)?

3. Explain what is meant by "territorial" behavior. Describe two types of territorial behavior. What are their purposes?

4. Describe two factors affecting food availability.

5. What is an advantage of raising two clutches? Are there any disadvantages?

IMPORTANCE OF THE ARCTIC TUNDRA AND SUMMER:

1. Explain why shorebirds breed in the Arctic tundra, and why they do this in the summer.

GENERAL CRITICAL READING AND CRITICAL THINKING QUESTIONS:

Directions: Answer the following questions in paragraph form on a separate sheet of paper.

1. Describe in detail two shorebird displays. Explain, if you know them, the differences in the roles of the male and female. What is the purpose (objective) of each display?

2. Describe the relationship between mating systems and natural selection.

3. Write a paragraph describing how the kindergarteners would get to Nicaragua. What would they require?

- Activity -

NESTING AND BREEDING: ANSWER KEY FOR WORKSHEET

Directions: Answer the following questions based on the "Nesting and Breeding" reading.

GROUND NESTS:

1. Describe two reasons why shorebirds nest on the ground.
   No trees in their *preferred habitat* (open tundra, beach, etc.). Can protect them by camouflage coloration, concealment, distraction behaviors, etc. Feet modified for ground.

2. A.) Describe two ways that shorebirds have adapted to protect their nests. B.) Are these behaviors? C.) What morphological (physical) traits do shorebirds need, if any, to accomplish this protection?
   A). Nest camouflaged by type of material used. Nest concealed among low plants. Incubating parent has feathers the color of surrounding ground and sits very still on nest. Parent attempts to distract intruders away from nest by exaggerated gestural displays like *"broken-wing act."*
   B). All involve behaviors to a greater (distraction displays) or lesser extent (choice of nest materials and to sit still).
   C). Ability to gather nest material. Color of feathers. Ability to sit still and to drag wing.

3. Why do so many shorebirds nest in wetlands?
   Abundance of invertebrate and plant food items. Presence of water, which provides hatching spot for insects. Growing young need local sources of nutritious food and water. (Plants conceal young of some animals, though this is not of significant importance with shorebirds.)

MATING SYSTEMS:

1. Describe two types of polygamy.
   One female mating with two males is polyandry. One male mating with two females is polygyny. Polyandry occurs commonly in phalaropes. White-rumped Sandpipers are polygnous.

2. What is a "pair bond"? Do polygamous birds form pair bonds? Explain.
   A pair bond is formed between two birds if they mate and maintain some mutual relationship after mating. Examples are both parents incubating, or one parent incubating while the other forages for its mate or the chicks. Polygamy refers to birds which maintain a pair bond with more than one mate. If no pair bond is maintained, the bird (generally male) that is mating with several others is referred to as promiscuous.

3. Compare and contrast monogamy and promiscuity in shorebirds.
   Both are mating systems which shorebirds are known for. Monogamous individuals mate with only one other bird per breeding season, and form pair bonds with them. Promiscuous individuals, like the male Buff-breasted Sandpiper, mate successfully with more than one bird in a season and do not form pair bonds.

4. Why does "lekking" imply that the birds are promiscuous?
   Lekking refers to a group of male birds attracting female birds on to a lek, rather than a nesting territory, for the purpose of mating. Lekking birds rarely form pair bonds.

5. Describe two mating systems that Sanderlings may use. Which is most common?
   Sanderlings are most commonly monogamous (with both parents sometimes caring for 2 separate clutches), but may also exhibit polyandry (described above).

6. Which is the most common mating system among shorebirds?
   Monogamy.

VISUAL DISPLAYS AND OTHER BEHAVIORAL ADAPTATIONS:

1. Why is it important that breeding grounds aren't disturbed?
   Shorebirds are "hard-wired" (behave according to instinct) to return to traditional sites year after year. No time in short summer to look elsewhere. Amount of available Arctic habitat may be limited.

2. Why do males display (before copulation)?
   Attract females to themselves or their territories. Initiate courtship with females. Defend territory from intruding males.

3. Explain what is meant by "territorial" behavior. Describe two types of territorial behavior. What are their purposes?
   "Territorial" behavior is behavior designed to advertise the holding of a territory. Males advertise their territory to females who are searching for a fit mate and appropriate (safe and with good food availability) nest site. Males also display (songbirds sing and defend; shorebirds gesture, call, and defend) to let other males know presence or boundaries of a claimed and defended territory.

4. Describe two factors affecting food availability.
   Season affects because insects and vegetation die off in the fall and winter. Time of day or season can affect because insects are active and available at different times. Patchiness versus even distribution affects where food is found. Geography affects the type of food available because suitable habitats may not occur in certain parts of the globe or at certain elevations, etc. Presence of many competitors which use the same food can limit food availability. Even presence of predators affects ability to reach food.

5. What is an advantage of producing two clutches? Are there any disadvantages?
   Extra chances for a pair, or for a polygamous individual, to pass on genes. New chance to pass on genes if the first clutch dies. Disadvantages if there are two simultaneous clutches or broods can include less parental care per brood. Disadvantages to producing a second clutch after the first fails can include less time to grow to fledgling state. Also, needed energy is consumed by a pair which needs to soon migrate.

IMPORTANCE OF THE ARCTIC TUNDRA AND SUMMER:

1. Explain why shorebirds breed in the Arctic tundra, and why they do this in the summer.
   The Arctic tundra is wetland habitat which offers a spectacular bloom of insect prey each summer. It also offers shelter and other food items. As an extension, we may also say that the presence of all members of a species (i.e., the opposite sex) near each other and at the same time, increases the likelihood of successful breeding.

GENERAL CRITICAL READING AND CRITICAL THINKING QUESTIONS:

Directions: Answer the following questions in paragraph form on a separate sheet of paper.

1. Describe in detail two shorebird displays. Explain, if you know them, the differences in the roles of the male and female. What is the purpose (objective) of each display?

2. Describe the relationship between mating systems and natural selection.

3. Write a paragraph describing how the kindergarteners would get to Nicaragua. What would they require?
   Examples of requirements might include: Parental preparation in the form of fattening up children with food and giving them food and supplies (maps, airplane tickets, money) to take. Parental preparation in the form of teaching and instructing as to route to take and ways to behave. Innate instincts to go south, follow a certain path, stay dry, avoid danger, etc.

ADDITIONAL ACTIVITIES: *"NESTING AND BREEDING" GENERAL INFORMATION READING*

1. **Jigsaw.** Have students "jigsaw" the reading: assign one section to each cooperative group. A group reads and studies only its section and prepares an oral presentation with visual aids (pictures, maps, outline or vocabulary list on board, etc.) for the class.

2. **Research Ideas.** Have students research one or all of the following:

   A). Have students research to find one other animal, besides a shorebird, which falls into each of the following categories: Monogamous, Polygynous, Polyandrous (or Polygamous), Promiscuous.
   B). One other animal which is territorial in the breeding season, and one which is territorial in its nonbreeding season. Is it the male, female, or both who behave territorially?
   C). Three birds, other than shorebirds, which nest on the ground on the Arctic tundra, and three that nest on the ground in habitat other than Arctic tundra.
   D). Two other birds that engage in lekking. What habitat are their leks located in?
   E). What mating system do the following animals most commonly use? Do all individuals of each animal type use the same system? Do they use any systems that shorebirds don't use? Describe their particular mating system: voles, house flies, mosquitoes, salmon, foxes, bowhead whales, beluga whales, bald eagles, swans.

3. **Comparison of Strategies.** Have students compare the advantages of *colonial nesting* for seabirds with *territoriality* in shorebirds. How does habitat or distribution of food affect these nesting adaptations?

4. **Re-write for Younger Students.** Have high school students practice writing and critical reading skills while studying the general information on shorebirds by instructing them to re-write a portion of the essay as a 1-2 page reading for ***elementary-level students***. They will first have to decide what are the main points of the essay, and what points about shorebirds are important to get across to younger students.

5. **Quiz.** Have students prepare their own quiz of 10 questions (with answers) from the reading. Have them exchange these with a partner and grade them. Any grade assigned by the teacher afterwards should be based on participation.

6. **Vocabulary.** Instruct students to choose 10 shorebird-related vocabulary terms in the reading and define them. Additionally, have them select and define 10 general vocabulary terms (e.g. concave, permeable, temporal).

APPENDIX D

"SHOREBIRD FIELD STUDY" TASK CARDS

#1

Take a quick look around the wetland. How many birds do you see?

#2

Do you hear any sounds? Are any of these sounds bird songs or calls? How many different sounds and birds do you hear?

#3

Use the binoculars or spotting scope. Can you see any more birds? Describe them.

#4

Look for other signs of birds like feathers, tracks or probes in the mud.

#5

Watch the first bird that flushes when a flock takes off. Does that bird stay in the lead the whole time?

#6

Watch a shorebird probe in the mud. Can you tell when it finds food?

#7

Make a map of the wetlands showing where you saw the birds or signs of their presence.

APPENDIX E

INFORMATION ON SHOREBIRD SPECIES

SHOREBIRDS IN ALASKA

- 71 documented species of shorebirds have occurred in Alaska.
- 46 species have been documented breeding in Alaska; shorebirds constitute 17.6 % of all birds breeding in Alaska.
- 36 species are common, regular breeders; 10 species are irregular breeders or breed in small numbers.
- 40 of the 46 breeding species (87%) nest nowhere else in the United States.
    - 23 species nest only on coastal and alpine tundra in arctic and subarctic regions.
    - Most of the world's population of 3 species (Bristle-thighed Curlew, Black Turnstone and Western Sandpiper) and 4 subspecies (Dunlin [*pacifica*], Rock Sandpiper [*ptilocnemis* and *couesi*], and Short-billed Dowitcher [*caurinus*]) nest in Alaska.
    - Alaska hosts 100% of the western hemisphere populations of the Pacific Golden-Plover, Bar-tailed Godwit, and Red Knot (*roselari*).
    - 75% of the world's populations of Surfbirds and a race of Rock Sandpipers (***tschuktschorum***) breed in Alaska.
    - Alaska supports 50% of the world's population of Black Oystercatchers, Wandering Tattlers, Whimbrels (***hudsonicus***), and Hudsonian Godwits (*haemastica*).
- Shorebirds that breed in Alaska travel to Australia, South Pacific Islands, Africa, Southeast Asia, the "Lower 48" states, Central America, and South America to spend the winter.
- Only 7 species remain in Alaska, in any numbers, during the winter (Black Oystercatcher, Black Turnstone, Surfbird, Sanderling, Rock Sandpiper, Dunlin, and Common Snipe).

SEASONAL OCCURRENCE, BREEDING HABITAT, AND WINTERING AREAS OF SHOREBIRD SPECIES FOUND IN ALASKA

Species/subspecies	Status	Breeding Area	Breeding Habitat	Wintering area
Black-bellied Plover	B	WE/NO	low, wet tundra	NAM/CAM/SAM/OCE
American Golden-Plover	B	WE/NO/CE/SW	upland tundra	SAM
Pacific Golden-Plover	B	WE	upland tundra	OCE/AUS
Mongolian Plover	b	WE/SW	rocky tundra	SEA/OCE
Snowy Plover	v	NAM		
Common Ringed Plover	b	WE	sand/gravel beaches	AFR
Semipalmated Plover	B	WE/NO/SW/CE/SC/SE	sand/gravel beaches	NAM/CAM/SAM
Little Ringed Plover	v	ASIA		
Killdeer	B	SE/SC/CE	gravel beaches/pastures	NAM/CAM/SAM
Eurasian Dotterel	b	WE/NO	rocky tundra	AFR
Black Oystercatcher	B	SE/SC/SW	gravel/rocky beaches	AK
Black-winged Stilt	v	ASIA		
American Avocet	v	NAM		
Oriental Pratincole	v	ASIA		
Common Greenshank	m	ASIA		
Greater Yellowlegs	B	SE/SC/SW/CE/WE	muskegs/marshes	NAM/CAM/SAM
Lesser Yellowlegs	B	SE/SC/SW/CE/WE/NO	muskegs/marshes	NAM/CAM/SAM
Marsh Sandpiper	v	ASIA		
Spotted Redshank	m	ASIA		
Wood Sandpiper	b	SW	marshes	SEA
Green Sandpiper	v	ASIA		
Solitary Sandpiper				
cinnamomea	B	SE/SC/SW/CE/WE/NO	muskegs/marshes	CAM/SAM
Wandering Tattler	B	SE/SC/SW/CE/WE/NO	gravel beaches/rocky tundra	OCE/NAM/CAM
Gray-tailed Tattler	m	ASIA		
Common Sandpiper	b	SW	sand/gravel beaches	SEA/AUS
Spotted Sandpiper	B	SE/SC/SW/WE/CE/NO	sand/gravel beaches	NAM/CAM/SAM
Terek Sandpiper	m	ASIA		
Upland Sandpiper	B	CE/WE/NO	upland tundra	SAM
Little Curlew	m	ASIA		
Eskimo Curlew	E	NO	upland tundra	SAM
Whimbrel				
hudsonicus	B	SW/WE/NO/CE	upland tundra	NAM/CAM/SAM
variegatus	m	ASIA		
Bristle-thighed Curlew	B	WE	upland tundra	OCE
Far Eastern Curlew	m	ASIA		
Black-tailed Godwit	m	ASIA		
Hudsonian Godwit	B	SC/SW/WE	low, wet tundra/muskegs	SAM
Bar-tailed Godwit				
baueri	B	WE/NO	low, wet/upland tundra	OCE/AUS
Marbled Godwit				
beringiae	B	SW	upland tundra	NAM/CAM
Ruddy Turnstone				
morinella	B	NO	upland tundra	NAM/CAM/SAM
interpres	B	WE/NO	upland tundra	NAM/OCE/AUS

Black Turnstone	B	WE/SW	low, wet tundra	NAM
Surfbird	B	SC/CE/WE/SW	rocky tundra	SAM/NAM/CAM
Great Knot	m	ASIA		
Red Knot				
roselaari	b	WE/NO	rocky tundra	NAM/CAM/SAM
Sanderling	b	NO	low, wet tundra	SAM/CAM/NAM
Semipalmated Sandpiper	B	NO/WE/CE	low, wet tundra	SAM/CAM/NAM
Western Sandpiper	B	WE/NO/CE	upland tundra	CAM/NAM/SAM
Rufous-necked Stint	b	WE/NO	low, wet tundra	AUS/SEA
Little Stint	m	ASIA		
Temmick's Stint	m	ASIA		
Long-toed Stint	m	ASIA		
Least Sandpiper	B	SE/SC/SW/WE/CE/NO	low, wet tundra/muskegs	SAM/CAM/NAM
White-rumped Sandpiper	B	NO	low, wet tundra	SAM
Baird's Sandpiper	B	NO/WE/CE	upland tundra	SAM
Pectoral Sandpiper	B	NO/WE	low, wet tundra	SAM
Sharp-tailed Sandpiper	M	ASIA		
Purple Sandpiper	v	NAM		
Rock Sandpiper				
ptilocnemis	B	SW - Pribs, St. Matt, Hall	rocky tundra	AK
tschuktschorum	B	WE - St. Lawr, mainland	rocky tundra	NAM
couesi	B	SW - Aleutians	rocky tundra	AK
Dunlin				
pacifica	B	WE/SW/SC	low, wet tundra	NAM/CAM
sakhalina	B	NO	low, wet tundra	SEA
Curlew Sandpiper	b	NO	low, wet tundra	SEA/AUS
Stilt Sandpiper	B	NO	low, wet tundra	SAM/CAM
Spoonbill Sandpiper	m	ASIA		
Broad-billed Sandpiper	m	ASIA		
Buff-breasted Sandpiper	B	NO	upland tundra	SAM
Ruff	b	NO	low, wet tundra	AFR/SEA
Short-billed Dowitcher				
caurinus	B	SC/SW/WE/SE	muskegs/marshes/low, wet tundra	SAM/CAM/NAM
Long-billed Dowitcher	B	NO/WE/CE	low, wet tundra	NAM/CAM
Jack Snipe	v	ASIA		
Common Snipe	B	WE/SW/SC/SE/CE/NO	muskegs/marshes/low, wet tundra	NAM/CAM/SAM
Pin-tailed Snipe	v	ASIA		
Wilson's Phalarope	b	SC	marshes	SAM
Red-necked Phalarope	B	NO/WE/SW/CE/SC	low, wet tundra/marshes	SEA?/SAM
Red Phalarope	B	WE/NO	low, wet tundra	SAM
Keys:				
Status		**Breeding area**		**Wintering area**
B = regular breeder		NO = northern Alaska		OCE = Oceania
b = breeds in small numbers		WE = western Alaska		AUS = Australia
M = regular migrant		SC = southcoastal Alaska		SEA - Southeast Asia
m = migrates in small numbers		SE = southeastern Alaska		NAM = North America
v = vagrant		SW = southwestern Alaska		CAM = Central America
		CE = central Alaska		SAM = South America
				AK = Alaska

PREFERRED BREEDING HABITAT OF SHOREBIRDS *FOUND REGULARLY BREEDING IN ALASKA*

Low, Wet Tundra	Upland Tundra	Rocky Tundra
Black-bellied Plover	American Golden-Plover	Ruddy Turnstone
Hudsonian Godwit	Lesser Golden-Plover	Surfbird
Black Turnstone	Upland Sandpiper	Red Knot
Semipalmated Sandpiper	Whimbrel	Rock Sandpiper
White-rumped Sandpiper	Bristle-thighed Curlew	
Pectoral Sandpiper	Bar-tailed Godwit	
Dunlin	Marbled Godwit	
Stilt Sandpiper	Western Sandpiper	
Long-billed Dowitcher	Baird's Sandpiper	
Red-necked Phalarope	Buff-breasted Sandpiper	
Red Phalarope		
Gravel Bars/Beaches	**Muskegs/Wet Meadows**	
Semipalmated Plover	Greater Yellowlegs	
Killdeer	Lesser Yellowlegs	
Black Oystercatcher	Solitary Sandpiper	
Wandering Tattler	Least Sandpiper	
Spotted Sandpiper	Short-billed Dowitcher	
	Common Snipe	

PRIMARY MIGRATION ROUTES

Eastern Pacific Coast	**Continental**	**Western Atlantic**
Black-bellied Plover	Greater Yellowlegs	American Golden-Plover
Semipalmated Plover	Solitary Sandpiper	Hudsonian Godwit
Killdeer	Spotted Sandpiper	Lesser Yellowlegs
Whimbrel	Upland Sandpiper	Semipalmated Sandpiper
Marbled Godwit	Least Sandpiper	White-rumped Sandpiper
Black Turnstone	Baird's Sandpiper	Pectoral Sandpiper
Surfbird	Buff-breasted Sandpiper	
Red Knot	Common Snipe	
Western Sandpiper	Long-billed Dowitcher	
Dunlin	Stilt Sandpiper	
Short-billed Dowitcher		
Red-necked Phalarope		
Red Phalarope		
Trans-Pacific	**Within Alaska**	
Pacific Golden-Plover	Black Oystercatcher	
Wandering Tattler	Rock Sandpiper	
Bristle-thighed Curlew		
Bar-tailed Godwit		
Ruddy Turnstone		

Source: Brad Andres, U.S. Fish and Wildlife Service, Anchorage, AK.

Hey teachers!

Thank you for your interest in the Shorebird Sister Schools Program server. If you want to get your kids involved in hands-on bird biology and ecology, this is the place! The Shorebird Sister Schools Program list server lets your classroom become actively involved in tracking the spring migration of thousands of shorebirds. The list server was created to share this information among other schools, students, birders, scientists, and the public. It is a great opportunity to involve your classroom in a project on an international level. Hundreds of messages from all over the world are posted on the server each year.

It's easy to participate and get your students involved as well as increasing your knowledge of shorebirds, those fascinating continental commuters! Enclosed is a sheet of step by step instructions that you can give to students or tape to your computer(s). When the students want to share their information with other enthusiastic birders just have them follow the steps on the card. This can happen after a planned field trip of bird watching to your local wetlands or if students have seen shorebirds elsewhere. The Shorebird Sister Schools Program is a fun and educational way to learn about shorebirds and the environment around us. Enjoy!

If you have any questions please contact Heather Johnson at e-mail: heather_johnson@fws.gov

Also, if you want to find more interesting information and activities on shorebirds, cruise our world wide web site at: http://www.fws.gov/~r7enved.sssp.html

Welcome!

Hey students and shorebird penpals!

Would you like to:

- Make penpals around the world that have similar environmental interests with you?
- Learn about shorebirds, those coastal continental commuters?
- Ask biologists and other people around the world about shorebird ecology and biology?
- Be a biologist yourself and add your "field data" and observations about shorebirds to the SSSP e-mail message board?

If any of these suggestions sound interesting to you, maybe you want to get involved with shorebirds. Ask your teacher about SSSP program.

If you want to find more interesting information and activities on shorebirds, cruise our world wide web site at: http://www.fws.gov/~r7enved.sssp.html

See ya on the Super Shorebirds Highway!
Oxy, the western sandpiper

SHOREBIRD SISTER SCHOOLS PROGRAM

Internet Address:
http://www.fws.gov/r7enved/sssp.html
U.S. Fish and Wildlife Service, Alaska
Division of External Affairs

Cruise the Super Shorebird Highway!

Each year, arctic-nesting shorebirds migrate from their wintering grounds in Latin America, Hawaii and Australia to their nesting grounds in Alaska and the Canadian Arctic. Shorebird migration is one of the most fascinating of all migrations; some shorebirds fly thousands of miles without stopping to rest or feed. Now students from all over the Western Hemisphere can track arctic-nesting shorebirds along their migration routes and share their field experiences with other students.

Students

Get on-line and learn about shorebird ecology and migration. Discover amazing facts about shorebirds and find fun activities to test your biology skills. Sign up for the free shorebird list server through your electronic mailbox. Ask biologists questions about shorebirds, document the shorebird sightings in your area, and receive mail from other students from around the world.

Teachers

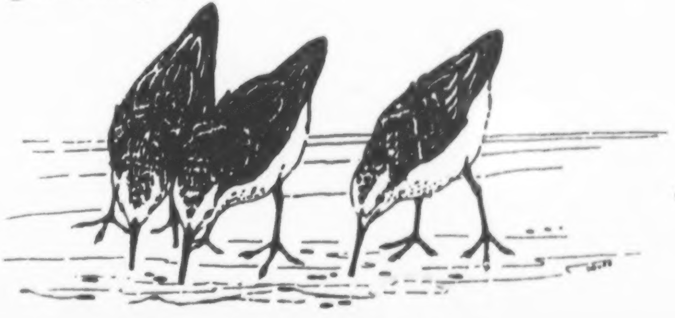
Within the Shorebird Sister Schools Program you will find a variety of multidisciplinary activities for the classroom and an extensive section on how to conduct a shorebird field trip. Help your students learn about shorebird migration and ecology and about the variety of cultures of students throughout the Western Hemisphere.

List Server

Subscribing to the list server is easy... and it is free! Simply send e-mail to listserv@www.fws.gov with "subscribe fws-shorebirds-digest Your Full Name" in the body of the message.

Questions??

For more information on the Shorebird Sister Schools Program contact Environmental Education Specialist, Heather Johnson, at (907) 786-3367 or send an e-mail to Heather _Johnson@mail.fws.gov.



drawings by G.C. West

To post a message with the SHOREBIRD SISTER SCHOOLS PROGRAM

1 Turn on computer
2 Type in your password
3 Double-click on your e-mail icon on your screen
4 Compose new message and enter the SSSP address
    fws-shorebirds-digest@www.fws.gov
5 Post your message
    a shorebirds seen
    b questions for experts
    c messages to penals
6 Remember to include the following information for shorebirds seen
    a name of your school
    b where they were seen
    c types of shorebirds
    d number of shorebirds
7 Send message and exit e-mail

To post a message with the SHOREBIRD SISTER SCHOOLS PROGRAM

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2 Type in your password
3 Double-click on your e-mail icon on your screen
4 Compose new message and enter the SSSP address
    fws-shorebirds-digest@www.fws.gov
5 Post your message
    a shorebirds seen
    b questions for experts
    c messages to penals
6 Remember to include the following information for shorebirds seen
    a name of your school
    b where they were seen
    c types of shorebirds
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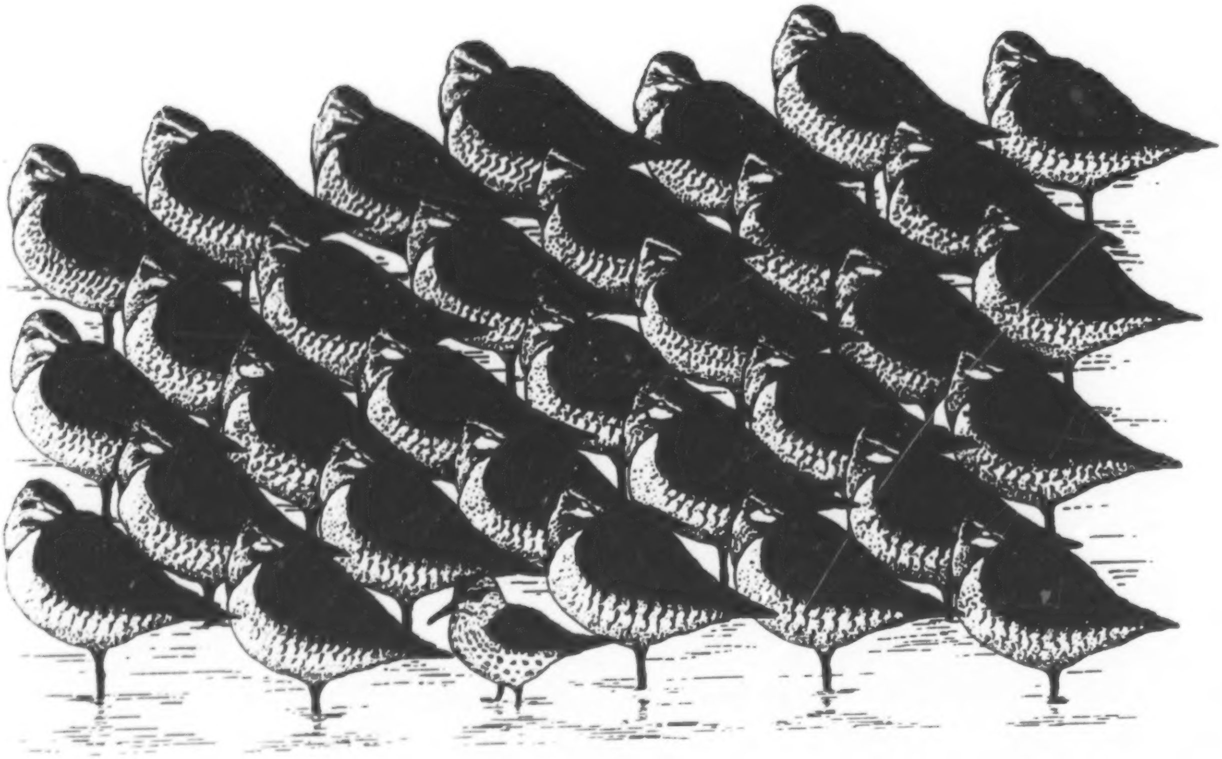
SHOREBIRD SISTER SCHOOLS PROGRAM

1997



U. S. Fish and Wildlife Service
1011 East Tudor Road
Anchorage, Alaska 99503

SHOREBIRD SISTER SCHOOLS PROGRAM 1997

Introduction

The Shorebird Sister Schools Program (SSSP) was founded in the winter of 1995 to encourage the protection and preservation of wetland habitats and the shorebirds that depend on them. The program provides a forum for students, teachers, and the general public to present, discuss, and learn about shorebirds, their migration, distribution, food habits, behavior, and habitat usage. Because shorebirds are distributed worldwide, they provide the program with a universal vehicle to educate the public of the necessity to protect and preserve wetland habitats.

Shorebird populations have decreased in recent time as human populations have invaded wetlands with their developments. The program teaches students and the general public how these attractive and appealing birds depend on specific wetlands during their extensive northward and southward migrations as well as during the summer breeding season and in winter. This information is especially aimed at school-age children who may become better environmental stewards and extend the survival of shorebird species populations into the future.

The formation of the program arose from the annual Kachemak Bay Shorebird Festival held in Homer each spring. Now in its fifth year, the festival has attracted hundreds of birders and shorebird enthusiasts each spring to view the spectacle of shorebird migration. The SSSP, through its e-mail list server, fws-shorebirds-digest, and its Home Page on the World Wide Web, has expanded along the Pacific flyway from Alaska to South America, the Pacific islands, and to Russia. In the past year, many new schools and countries have used the list server and the web site as part of their environmental programs. Further information on the history of the program may be found in the 1996 report.

The SSSP is an environmental education program of the U. S. Fish and Wildlife Service (USFWS), and is managed by Heather Johnson out of Anchorage, Alaska. Over the past year, the program has acquired over $30,000 to carry out its objectives. Funds came primarily from a $20,000 Challenge Cost Share agreement through the USFWS. Partners in the Challenge Cost Share agreement included: USFWS, Alaska Department of Fish and Game, Prince William Sound Science Center, San Francisco Bay Bird Observatory, Dr. George C. West, Alaska Natural Resource and Outdoor Education, Yuriria Blanco Castillo (Mexico), Birds Down Under (Australia), and the National Wildlife Federation.

The Division of Refuges, USFWS, also contributed $8,000 towards workshop/classroom visits and educational kits for the refuges within areas where shorebirds occur in Alaska. These funds were used to allow Diana Brann, Seasonal Biotechnician for Migratory Bird Management, to travel to Kotzebue, Alaska, within the Selawik National Wildlife Refuge, and conduct classroom visits for one week in the village, reaching K – 12 age students. She also met with the teachers to share the new Arctic-nesting Shorebird curriculum with them (even though it is still in draft form). She did a similar program for the communities of Cold Bay and King Cove. Kits were developed for Togiak, Alaska Peninsula/Becharof, Selawik, Izembek, and Yukon-Kuskokwim Delta National Wildlife Refuges. The kits include shorebird resource books, a copy of the curriculum, a slide set with a script, puppets with a puppet show script, maps, binoculars, and materials to conduct several of the activities in the curriculum.

The Anchorage Audubon Society made a $1,000 contribution to the program. The funds are being spent for a Russian translation of the curriculum.

World Wide Web Site Home Page

The web site for the SSSP, located at < http://www.fws.gov/~r7enved.sssp.html >, was established in 1996 to provide shorebird and wetlands information and educational resources for school teachers through curricula for their school's environmental education programs. In addition to general information about shorebirds and wetlands, it contains a vast array of information, in English and Spanish languages, about related programs, festivals, agencies, and sponsors of the SSSP. From the web site, you can download curricula including shorebird information for kids and teachers and classroom activities. You can obtain migration updates for various species in a number of locations, view a map of the major shorebird migration routes, read the latest news of shorebird arrivals during their southward fall migration, and learn about rare shorebird sightings. You may sign up to participate in discussions about shorebirds on the e-mail list server, obtain a 16-page list of bird festivals throughout North America, download shorebird outlines for coloring and photographs of most species of North American shorebirds. You can find referrals to other web sites that contain birding information relative to conservation and protection of bird species.

This year has seen a major expansion in the content and coverage of the web site as well as its usage. New this year are site descriptions for each of the major stopover locations on the Pacific Flyway. When you click on a specific site, additional information is given for each site, including photographs of many of the sites as well. Some sites go directly to another web page (e.g., to a refuge). A mini slide show was added to the first page. Also added were quizzes for kids to try their shorebird identification skills and links to a variety of additional sites related to wetlands, shorebirds, or other related bird species. A Spanish web site was developed including many of the activities from the curriculum and background information about shorebirds. A new site was created about Puerto Rico and the birds that live there. It includes background information, colored photos of birds, and a quiz about the various wetland habitats in the area. A shorebird coloring book was added, compliments of George West, who contributed several black and white sketches that kids could print out and then color in. They can also print color photographs of the same species and compare as they color their birds. A "What's New Today" section was created, that includes fun information about other related sites, new programs that kids can join on bird education or field trips, and other fun links. A translation of parts of the web site into Portuguese will soon be added. The data collected by the students in the field and posted on the list server were again added to the web page so that other students could access the data. (See summary of comments in Reports from Cooperators and Subscribers below).

Web Site Home Page Analysis

From August 1996 through July 1997 (12 months), 74,822 requests for information on the web site were made (Table 1). Data for only two months (April and May) are comparable between last year's (1996) and this year's (1997) web site use. There is an increase of 268% (2.7x) in 1997 as compared with 1996 (24,387 vs. 9,089). In 1996, only 21 foreign countries used the web site, while in 1997, this number grew to 53, or a 252% (2.5x) increase. In both years, Canada used the web site more than any other nation except the United States. Percentages of use between years for the principal categories remained about the same, e.g., for United States users, 56.4% of the total users in 1996 compared to 57.6% in 1997; Foreign countries users, 7.6% in 1996 and 8.6% in 1997; unidentifiable users, 35.5% in 1996 and 33.8% in 1997.

It is interesting to trace the monthly use of the web site since its inception in spring 1996 (Figure 1). During spring migration in 1996, there was a slight rise in use which fell off after the migration and when most schools closed in June. However, there was a gradual increase throughout the summer and fall, a slight fall-off in winter perhaps due to the holidays, and then a rapid increase during the entire spring migration in 1997. Again use declined after the migration and when schools closed. However, interest remained high through the summer of 1997.

E-mail Communications – the List Server

In 1996, the SSSP established a list server to permit open transmission of information among schools, students, birders, scientists, the general public, and managers of the SSSP. To subscribe to the list, send an e-mail message to < majordomo@www.fws.gov >. In the message box write only the following: < subscribe fws-shorebirds-digest >. Hundreds of messages are posted each year and are made available to readers in digest form (groups of messages are assembled and sent out in one post). At the same time, the most interesting shorebird messages are summarized on the web site home page, from which anyone can download all the messages for that date.

At the end of the 1997 report year, there were 640 subscribers to the List Server (Table 2). Of the total, 563 were from the United States and the balance, 77 subscribers were from a total of 23 foreign countries. Canada and Mexico had the greatest number of subscribers as might be expected from the flight path (Pacific Flyway) of shorebirds in North America. The number of subscribers represents a 256% (2.5x) increase over the number of subscribers at the end of the report year, 1996 (640 vs. 250). The breakdown of the affiliations of the 250 subscribers in July 1996 is unavailable. However, earlier records, for April and May 1996, show that there were only 180 total subscribers with 9 foreign countries represented (Table 2). Some of the increase from 1996 to 1997, is due to greater awareness of the existence of this service – and some to an increasing interest among scientists, educators, and the general public in shorebirds and wetland habitat conservation. The former is largely due to the efforts of the SSSP management in their visits to schools and agencies throughout the Pacific Flyway and in Central and South America and in Russia.

By examining the e-mail addresses of current educational institution subscribers, it is possible to determine that at least 31 states of the United States and seven Canadian Provinces are represented (AK, AL, AR, AZ, CA, CO, CT, FL, IL, IN, KS, KY, LA, MA, MD, ME, MN, MO, ND, NJ, NV, NY, OH, OK, OR, SC, SD, UT, VT, WA, WI; AB, BC, ON, NB, PE, QC, SK). Interest in the list server seems to be spread evenly throughout northern North America and is gaining in interest in Mexico and other countries.

Reports from Cooperators and Subscribers to fws-shorebirds-digest

Following is a summary of the many reports received by the fws-shorebirds-digest chat line during spring and summer 1997. These are listed here, not so much for the shorebird information they contain, but to demonstrate the great interest shown by the public and birding community from all over the world in shorebirds and wetlands conservation based on the study and observation of shorebirds.

March 9. Eriko Fujioka reported numbers of 10 species of shorebird on the Shiokawa tidal flats in **Japan**. His report included observations also for 16 and 20 March, and 6 and 9 April from the same location.

March 28. Amy Hutzel, Don Edwards San Francisco Bay National Wildlife Refuge, reported many shorebirds at **Bolinas Lagoon, CA**, a famous shorebird location.

March 28. John Sjovall reported migrating Lesser Yellowlegs and Killdeer at **Madison and Guilford, CT.**

March 31. Aram Terchunian noted that Piping Plovers had been spotted on **Long Island, NY.**

March 31. Patrick O'Hara reported on research on shorebirds near the City of Chitre in **Panama**, on the Pacific coast. By this date almost all of the Western Sandpipers had molted into breeding plumage and had left Panama. Many other shorebirds were still there and would soon follow.

April 7. Marcia and Keller MacDonald only found a few shorebirds at Ixtapa along the Pacific Coast of **Mexico** - Willet and Solitary Sandpiper.

April 7. E. Rollin gave a summary of shorebirds at Palix River, which are tidal waters **to Willipa Bay, WA.**

April 7. Bruce Bennett told of the frozen status of the headwaters of the Yukon River near **Whitehorse, YT** where he found Killdeer at M'Clintock Bay.

April 9 and 10. The Australasian Wader Studies Group conducted shorebird surveys at Chongming Dao, in the Yangtze River estuary, and the Yellow River delta, **China**, and counted 17,107 waders of 29 species on these two days. More than 200,000 shorebirds are estimated to use these sites during migration.

April 10. Margaret Kolar told the group about nesting of western Snowy Plovers, a threatened species, in the **San Francisco Bay, CA** area.

April 10. Peter Driscoll of the Queensland, **Australia,** Wader Study Group gave a report on shorebird studies in the East Asian-Australasian Flyway.

April 12. Jeff Wilson reported on groups of American Golden-Plover and other shorebird species on the bottoms of the Mississippi River area in **Tennessee**.

April 18 to 1 May. The Australasian Waders Study Group counted a total of 130,122 waders of 38 species along the shoreline of the Huang He Nature Reserve, **China**, in this period. They estimate that at least 500,000 waders utilize this site during northward migration.

April 19. Astoria High School students conducted shorebird surveys along the Columbia River Estuary near **Astoria, OR**. They set up transects and calculated the number of birds per kilometer along the transect. They have a web site where others can find all their counts.

April 19. Alan Craig reported an American Golden-Plover, a rare vagrant, at ponds near **Douglas, AZ.**

April 20. Molly and Dave Brann reported the first Greater Yellowlegs at Beluga Slough in **Homer, AK.**

April 20. Melinda Berg posted a note about Snow Buntings from **Barrow, AK.**

April 24. Nancy Norvell reported from the **Galapagos Islands** that few shorebirds stop there during migration, but rather hug the coastline of Central and South America.

April 24. Rob Butler, Canadian Wildlife Service, reported that about 12,000 Western Sandpipers were now on the **Fraser River Delta, BC.**

April 24. Roger Radd found 58 Marbled Godwits on a golf course in high winds at **Cornville, AZ** and a number of migrating sandpipers in **Sedona, AZ.**

April 22. Sue Earles, teacher at Beach Grove Elementary School, **Boundary Bay, Delta, BC**, took 28 students on a field trip to count shorebirds. They found large flocks of sandpipers and 240 Whimbrel.

April 23. Sue Earles checked the **Boundary Bay, BC** area again and found increasing numbers of shorebirds.

April 25. Amy Hutzel reported on high numbers of several shorebird species at San Francisco Bay National Wildlife Refuge with many of the local breeders nesting around **San Francisco Bay, CA**.

April 26. Peg Robertson found over 1,000 shorebirds on the shores of **Wrangell Island, AK** including Black Turnstone, Surfbird, Rock Sandpiper, and Short-billed Dowitchers. On 28 April, she found over 40,000 shorebirds (mostly Western Sandpipers) in a flight over the **Stikine River**.

April 26. Lori Byrne of the Maryland Department of Natural Resources posted her shorebird observations at **Assateague Island, MD** during the Delmarva Birding Weekend.

April 26 and 27. **Columbia River Estuary, OR** students conducted more transect counts and reported their findings.

April 28. John Jaeger was counting shorebirds at **Grays Harbor, WA** and saw 3,000 Western Sandpipers along with Dunlin, yellowlegs, Semipalmated Plover, and several other non-shorebird species.

April 28. Rob Butler told the group that Western Sandpipers were streaming into the **Fraser River Delta, BC** with over 100,000 birds present along with Black-bellied Plovers and Dunlin.

April 29 and 30. Sue Earles and her classes of the Beach Grove Elementary School in **Boundary Bay, Delta, BC**, counted sandpipers in the local salt marshes and tidal mudflats.

April 30. Lanny Randolph and Robin Harding reported finding Killdeer, Baird's Sandpiper, Dunlin, and Common Snipe at Funk Lagoon in southcentral **Nebraska**.

April 30. Susan Hengeveld reported on the migration of 10 species of shorebirds along the shore of a small lake near **Bloomington, IN**.

April 30. Diana Brann reported that flights over the **Copper River Delta, AK** had found over 100,000 shorebirds, 80% Western Sandpipers, 20% Dunlin, with a few Black-bellied Plover and Short-billed Dowitchers observed. She also noted that Greater Yellowlegs and Common Snipe had been seen in **Anchorage, AK**.

May 1. Molly and Dave Brann estimated the numbers of shorebirds in Mud Bay, **Homer, AK** at 2,000 Western Sandpipers, and many Dunlin, plovers, and dowitchers.

May 1 and 9. Students from Beach Grove Elementary School, **Boundary Bay, Delta, BC**, reported sightings of over 15,000 Western Sandpipers on 1 May and 100,000 on 9 May along with eight other shorebird species.

May 2. Students at Astoria High School visited several locations in the **Columbia River Estuary, OR** to count shorebirds on 2, 4, and 5 May where they estimated the number of each species per square kilometer of mud flats.

May 2. Bill Fontenot, Acadiana Park Nature Station, said that migrant shorebird traffic had slowed to a trickle in **Southern Louisiana**.

May 2. Duyen Tran told the group about his peace corps program teaching environmental education at Fundacion Pro-Pueblo in **Ecuador**, which included counts and banding shorebirds.

May 3. **Homer, AK** birders reported two Pacific Golden-Plover had arrived from Hawaii.

May 4. Fifty students in The Valley Home Schoolers program visited the Palmer Hay Flats near **Wasilla, AK** to count shorebirds and observe other birds and wildlife.

May 4. Steve Ganley reported on shorebird sightings near **Phoenix, AZ** where he found small numbers of 12 species.

May 5. Gary Broussard worked the rice fields in southern **Louisiana** again to count hundreds of shorebirds including White-rumped, Baird's, Semipalmated, and Stilt Sandpipers, Hudsonian Godwit, Ruddy Turnstone, Wilson's Phalarope, and Dunlin.

May 5 and 6. Brad Andres, U. S. Fish and Wildlife Service, gave numbers of shorebirds and other species observed at **Yakutat, AK** with a total of about 30,000 shorebirds migrating through there.

May 6. Ruud Kampf, **Netherlands**, was planning a trip to Alaska and wanted information from subscribers of fws-shorebirds-digest.

May 6. Students from the **Icy Bay, AK** School have been studying shorebirds and found many small flocks in a recent field trip.

May 7. Students from Tainana Elementary School in **Wasilla, AK** visited Kachemak Bay to observe shorebirds and study many aspects of marine biology. They were assisted by staff at the Alaska Maritime National Wildlife Refuge.

May 7. Heather Johnson reported on the status of shorebirds in **Homer, AK** as several thousand birds including Western, and Least Sandpipers, Dunlin, Semipalmated and Black-bellied Plovers, Short-billed Dowitchers, Greater Yellowlegs, Whimbrel, and a rare Red-necked Stint.

May 7. Gary Broussard found a Curlew Sandpiper, **Louisiana**'s fourth state record.

May 8. The Wasilla Home Schoolers came to study marine biology on Kachemak Bay at **Homer, AK** where they observed 6,000 to 10,000 shorebirds in Mud Bay as well as many other intertidal species of animal including *Macoma* clams, the favorite diet of many shorebirds.

May 8. Students from the Athenian Middle School and the Wasilla Christian School visited **Kachemak Bay, AK** to watch shorebirds and study marine biology.

May 8 and 9. Sixth grade students at Juneau Christian School and led by Gay Paresky counted shorebirds on the Mendenhall Wetlands near **Juneau, AK**.

May 9. The seventh grade science class observed shorebirds near the Situk River, **Yakutat, AK**, where they found many sandpipers and other birds.

May 9. Janet Hanson, San Francisco Bay Observatory, noted that migration of thousands of shorebirds continued northward, but at the same time, several species had already hatched chicks in the **San Francisco Bay, CA** area.

May 10. **Cordova, AK** is holding its annual shorebird festival, reports Diana Brann. The Copper-Bering River Delta system is host to the largest concentration of shorebirds on the Pacific coast. Hundreds of thousands of shorebirds are moving through today.

May 10. The Boy Scouts of Hamilton District Pack 92 celebrated International Migratory Bird Day at San Francisco Bay National Wildlife Refuge where they conducted a shorebird count. They note that most sandpipers have left the **San Francisco Bay, CA** area.

May 10. Students again counted shorebirds on the **Columbia River Estuary, OR** at Trestle Bay, Wireless Road, and Clatsop Beach, where they found thousands of migrant shorebirds.

May 11. The Kachemak Bay Shorebird Festival ended today reports Heather Johnson from **Homer, AK**. An enthusiastic crowd of visiting and local birders saw about 10,000 shorebirds of 18 species.

May 11. Kyle and Keegan Irving, Home Schoolers, from **Cordova, AK** sighted flocks of Western Sandpipers at Hartney Bay.

May 12. The **Australian** Bird Research Centre used the fws-shorebird site to ask for information on bird migration related to a paper they are writing.

May 12. Gary Broussard counted over 1,000 shorebird migrants in the rice fields of southern **Louisiana**.

May 16. Mary Anne Bishop and Patrick Green summarized the shorebird migration picture on the Copper River Delta near **Cordova, AK**. They found that Western Sandpipers arrived on 21 April and Dunlin on 23 April. Red Knots arrived in considerable numbers on 8 May. As of 16 May, many Westerns and Dunlin had left but there were many plovers, dowitchers, and Sanderlings still moving through.

June 30. A long letter from several teen-age girls in Puerto Rico was posted, describing their life there, but with little about shorebirds.

July 24. Annette Moen gave a web site address to look at birds seen in the Esquimalt Migratory Bird Sanctuary, in the **Pacific Northwest**.

July 25. Ruud and Kitty Kampf gave a long report on shorebirds in the **Netherlands** and **Alaska** with a discussion of their recent trip to Alaska.

July 26. Brent Ortego reported on his banding of shorebirds on the central **Texas** coast.

July 29. Yuriria Blanco Castillo told of her efforts to organize a shorebird festival in Veracruz, **Mexico.**

Reports and Messages from the Managers of fws-shorebirds-digest

April 1. Diana Brann posted a series of questions and answers about how shorebirds use their bills – and asked interested persons to check the web site for more information. Also included was a discussion by Brad Andres about oystercatchers and their prey.

April 5. A message describing the Shorebird Writing Contest as a part of the annual Kachemak Bay Shorebird Festival was posted for fws-shorebird-digest readers.

April 16. Diana Brann posted questions and information on shorebird feet.

May 23. Diana Brann sent out a request for information from subscribers. (See Responses below.)

June 30. Lee Tibbitts gave a report on breeding of shorebirds in Cook Inlet, including interesting details on Greater Yellowlegs, Hudsonian Godwit, Lesser Yellowlegs, and Short-billed Dowitcher. They were making field observations and banding birds.

June 30. Diana Brann reported from Dillingham where she and a coworker are conducting bird surveys on nesting shorebirds.

June 30. Heather Johnson reported on her trip to Latin America where she met many people participating in and interested in the SSSP. She explained her activities while in Mexico that included introduction of the program to educational groups and agencies. She also reported on the workshops conducted in Alaska.

July 23. Heather Johnson discussed the beginning of fall migration and requested input from observers around the world.

July 24. A new book "Disappearing Lake" by the author of "Flight of the Golden-Plover", Debbie Miller, was announced and recommended for children. July 25. Diana Brann posted a request for information on shorebird viewing areas and field trips in the San Francisco Bay area.

July 25. A long message requesting support for marine conservation efforts was posted.

July 29. An RBA (Rare Bird Alert) report was posted from Nebraska about shorebirds seen the previous week there.

Responses to the Questionnaire: Information from Subscribers

Following is a summary of information received from 20 subscribers in response to the questionnaire sent out by Diana Brann on June 30. Question asked are in italic in the following summary.

Affiliation: [Totals will not add to 20 as some individuals listed more than one affiliation]: educator (4), biologist/researcher (4), birder (6), naturalist (9).

State or Country: AK (6), BC (1), CA (2), HI (1), MA (1), MD (1), OH (2), WA (1), YT (1), The Netherlands (1).

How long have you been part of the SSSP: Average of 18 responses = 0.98 years (range 1 month to 2 years).

What do you like best about the program: Contact with other countries (2); Information on shorebirds; International overview of shorebird migration; Information on migration; Information on spring arrivals; Connection among schools; Fascination with shorebird migration; Tracking the migration (2); Active involvement of children; Well-developed curriculum materials; Reading about interchange of ideas between school children and birders; Discussion groups and the curricula; Reading the e-mail reports; reading about shorebirds; Scientific studies; Sculpting young minds.

Your information comes most from: List Server (13); Home Page (1); Both (4).

Do you plan to participate in future: Yes (13)

Would you be interested in an educator workshop: Yes (7); No (3); Already have (2).

Comments or Suggestions: Nice Service; Great program (2); Helps explain why shorebirds are so important; Wanted to participate if had more time; Wants more personal comments from children about shorebirds; Suggest a writing program based on shorebirds; Keep up the wonderful job (2); Be more selective in posts to the List Server – should be more wader related and not so general about wetlands; Terrific program.

Other Evaluative Comments

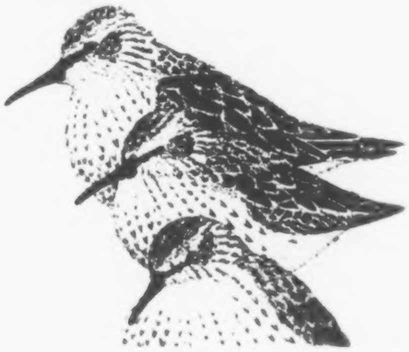
From Petersburg, Alaska – I just found the Shorebird site on the Internet. Great project. I am looking forward to reading about this spring's migration. Although I am neither a teacher, nor a hard-core birder, I enjoy watching the shore bird migrations as they pass through Wrangel, Stikine River Delta, and Petersburg. Please note that although most of the Stikine watershed is in British Columbia, the Stikine River Delta, where the shorebirds stop, is totally in southeast Alaska. This was the result of one of the many quirks of political decision-making during the establishment of the Canada-United States border. Thanks for the wonderful web site.

From Anchorage – I really enjoyed surfing through the Surfbirds and other shorebirds on your shorebird home page. The maps are really good tools to have on a desktop computer. Keep up the great work in Fish and Wildlife Service Education. (B. Dennerlein, National Audubon Society, Anchorage)

From North Carolina – Several Fish and Wildlife Service folks have told us about the Shorebird Digests. We have heard that it may be expanded? We would love to get some east coast stuff in the network. Can we pursue this? How do we go about it? We are in the process of putting together some home pages for both Alligator River and Pea Island Refuges. Of course, the shorebird stuff is bigger than that – but I can put Bob Noffsinger (Biologist for North and South Carolina) in touch with you, if you are interested in going after an expansion that would include the east coast. Everybody's raving about the pages you have! Great job!

From Hamilton, Ontario – Your site is terrific! I have monitored spring and fall shorebirds for the ISS program for about 15 years in the Dundas/Hamilton area in southern Ontario. While my birds do not use the Pacific Flyway, I would still be very interested in some way of participating in your program. (M. Clark)

From the Matanuska Valley, Alaska – I wanted to personally thank you for all your hard work and enthusiasm in working with the Valley Home Schoolers. We all thoroughly enjoyed the teacher training, workshops, field trips, and especially Club Mud! I cannot believe how much my kids learned and how thrilled they were at seeing the birds first hand in Homer! I particularly enjoyed your web site and the cool stuff there! I think having been through the teacher training and workshops, that the Valley Home Educators Support Team (VHEST) could easily do its own workshops in the spring, and if your were willing, perhaps have you accompany us again to the Palmer Hay Flats next year! Again, thank you for all your logistical planning and especially your enthusiasm. (J. Orr, VHEST)



Programs Conducted for the Shorebird Education Program by Staff

Director Heather Johnson conducted classroom visits and teacher workshops in the villages of Point Hope, Point Lay, Atqasuk, Barrow, Nuiqsut, Kaktovik, Wainwright, Gambell, and Savoonga, Alaska. Teacher Inservice Training Programs were conducted in Cordova, Seward, and Kenai, Alaska. All of these Inservices were open to teachers within the local school district. Two special workshops were conducted on shorebirds and seabirds for the Palmer and Wasilla Home Schoolers and for Clark Middle School. A teachers' workshop was also conducted at the fifth annual Kachemak Bay Shorebird Festival in Homer, Alaska. Staff conducted two-day migratory bird education workshops at the Summer Academy in Anchorage and at the Annual Partners in Flight meeting for Alaska covering everything from shorebirds to seabirds, songbirds, raptors, and waterfowl.

Heather Johnson taught two shorebird workshops at the National Wildlife Federation Summit in Seward, Alaska in June 1997. She also presented the Shorebird Sister Schools Program at the North American Association of Environmental Education in Vancouver, BC in August 1997.

A Challenge Cost Share proposal was awarded to conduct migratory bird education programs in all of the North Slope villages in Alaska. The agreement was between the North Slope Borough School District, the USFWS, and Adriana and Arturo de Castro from Quintana Roo, Mexico. Adrian and Arturo run an Environmental Education Center in Quintana Roo and have been assisting with a pen pal program between Barrow middle school children and children from Quintana Roo.

Heather Johnson traveled to the North Slope Borough school in the winter of 1997, doing classroom visits on seabirds and shorebirds. She also conducted teacher workshops.

There were several SSSP activities at both the Kachemak Bay Shorebird Festival and the Copper River Delta Shorebird Festival. Some of the programs included school group field trips to view shorebirds, indoor programs for school groups, family field trips, and interactive displays at the indoor fairs.

Yuriria Blanco Castillo, the Education Coordinator at the Institute of Ecology in Xalapa, Veracruz, Mexico, worked for us as a volunteer during the months of April and May 1997. She translated several of our shorebird materials into Spanish, including several of our postings to the shorebird list server, the slide show, puppet show, and many of the curriculum materials. Yuriria and Diana Brann offered shorebird education programs in both Yakutat and Icy Bay, Alaska, and at the Copper River Delta Shorebird Festival in Cordova, Alaska, and gave many classroom presentations.

In May 1997, Heather Johnson traveled to Guadalajara, Mexico to attend the II Congresso Iberoamericano Environmental Education Workshop. Heather presented the SSSP with Yuriria Blanco Castillo assisting with translation. There were over 1,000 educators from all Spanish speaking countries. Over 30 people attended the SSSP presentation and Heather and Yuriria passed out materials to several hundred people at the workshop.

Heather Johnson traveled to Smolenskoye Po'ozerye National Park, Russia, to present the SSSP at an outreach and education workshop for Park and Zapovednik directors and outreach specialists in Russia. Heather shared the materials for the SSSP and new Russian partners were added to the fws-shorebirds-digest list server.

Shorebird education kits were developed for several Alaska refuges, including Alaska Maritime, Alaska Peninsula/Becharof, Izembek, Togiak, Selawik, and the Yukon Kuskokwim Delta National Wildlife Refuges. Two other kits were developed that will stay in Anchorage for distribution to schools. The kits at the refuges will be used by refuge staff and checked out to village schools. Another kit was produced and sent to Xalapa, Veracruz, for Yuriria Blanco Castillo to use in Mexico.

A shorebird slide show was produced and distributed to all National Wildlife Refuges. Several other copies will be available for interlibrary loan to schools.

The Arctic-Nesting Shorebird Curriculum is nearly completed and should be available for distribution by January 1, 1998. The curriculum is in the process of being translated into Spanish and Russian. The translated versions should be available by the spring of 1998.

Needs for the Coming Year

Although we had an increase in the number of postings to the list server this year, given the number of subscribers (almost 650) there could and should be more. We need to provide additional training to families, teachers, and shorebird enthusiasts and encourage them to get personally involved by posting data and observations to the list server. Everyone says they love the postings made by others, but many are not comfortable making their own postings.

This year, we have received many requests to expand the program to include the Atlantic Coast and shorebird sites in the Midwest. Although the list server is open to anyone that wants to participate, it is difficult for teachers to involve their students without the essential background information from the World Wide Web. In order to expand the program to the East Coast and other flyways, it would be necessary to increase both staffing and funding. There are many ways this could be achieved. The program could continue to be funded through Region 7, USFWS in Alaska; additional funding would make it possible to expand the project. Another way to run the program would be to move the program to the Washington Office, USFWS, to administer the program as a national project. The program could also be supported by non-governmental organizations or perhaps administered through a creative partnership. All these scenarios are being investigated.

A Challenge Cost Share proposal will be submitted for this coming year. Anyone interested in being a partner organization and contributing funds or in-kind services to the project, please call Heather Johnson at (907) 786-3367 or send an e-mail to: <heather_johnson@mail.fws.gov>.

Other contributions to the program could include:

1) Making links to SSSP from other good web sites,
2) Contributing slides or drawings of

shorebirds or wetland habitats,

3) Contributing shorebird field trip data to the fws-shorebirds-digest list server,
4) Contributing volunteer time to assist in a classroom, hosting a workshop for teachers in your area, or helping students with a shorebird field trip,
5) Inviting a group of students to a National Wildlife Refuge in your area to view shorebirds and other water birds,
6) Donating computer equipment to local schools to allow them the opportunity to join us on the "Super Shorebird Highway",
7) Providing translations for our bilingual partners in the SSSP,
8) Sending care packages to our "sister schools" in other countries, including things like art supplies, slides or pictures of shorebirds, posters, puppets, books, etc.,
9) Becoming involved with your local community to help protect shorebird and wetland habitats,
10) Assisting at a local shorebird festival,
11) Other ideas? We would like to hear from you! Call SSSP Director, Heather Johnson at (907) 786-3367 or send an e-mail to <heather_johnson@mail.fws.gov>.

Future Plans

1. We plan to expand the SSSP within the United States and other areas, if possible. The focus to date is on the Pacific Flyway and the shorebirds that nest and breed in Alaska and the Canadian Arctic. The places that are most involved are West Coast communities primarily in British Columbia because the birds that pass through that region are the Arctic nesting breeders that the program focuses on.

2. We would like to expand the World Wide Web site to include more information for the other flyways used by migrating shorebirds and include the nesting areas of birds that use central and eastern parts of Canada or remain in the lower-48 and nest and breed near freshwater bogs, lakes, marshes, and streams or along the coast.

3. We plan to increase our focus on National Wildlife Refuges and to invite school children to the refuges to conduct their shorebird field trips.

4. We plan to work very closely with Manomet, Inc, to incorporate some of the ideas of the SSSP into their education program, utilizing their Western Hemisphere Shorebird Reserve Network web page as a reference and link to the Shorebird Sister Schools web page.

5. We plan to continue to look for increased funding for expansion, including grants (National Fish and Wildlife Foundation, Challenge Cost Share Grants and others) to fund the program.

6. An informational packet will be developed in the fall and winter of 1997/98 that will be sent to anyone requesting it. The packet will include step by step information on how to participate in each of the elements of the shorebird program. It will have notes on how to subscribe, unsubscribe, and make postings to the fws-shorebirds-digest list server. It will include information on how to get into the web page, and will have basic field trip information with a data sheet for the students and instructions for teachers on how to use it.

7. Plans are to continue to use a contractor to assist with the web page design and have USFWS employees coordinate the other elements of the program.

Table 1. General Statistics - Requests (Hits) on the Web Page 1996 - 1997

			1996			Number of Requests					1997			Percent
Parameter	Month	Aug*	Sept	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	TOTAL	of Total
Total Number of Requests		3161	3383	3617	4284	3962	4405	5465	8336	13620	10767	6244	7578	74822	100.000%
Requests by Organization															
United States (subtotal)		1930	2102	2002	2306	2377	2698	3095	4390	7439	6316	3921	4541	43117	57.626%
U. S. Commercial (.com)		802	923	706	955	694	991	903	1438	2297	1864	1452	1904	14929	19.953%
U. S. Educational (.edu)		358	471	499	440	569	452	630	811	801	906	584	561	7082	9.465%
U. S. Government (.gov)		257	259	226	130	224	254	338	385	545	701	272	296	3887	5.195%
U. S. Military (.mil)		22	2	27	29	60	10	35	1	47	65	12	76	386	0.516%
United States (.us)		116	84	64	54	25	131	305	63	283	628	394	165	2312	3.090%
Networks (.net)		366	355	462	684	739	785	823	1675	3339	1993	977	1398	13596	18.171%
Non-Profit (.org)		9	8	18	14	66	75	61	17	127	159	230	141	925	1.236%
Other Countries (subtotal)		292	299	291	414	374	455	478	606	991	865	709	666	6440	8.607%
Argentina								5						5	0.007%
Australia		23	12	24	32	15	31	27	1	40	56	31	56	348	0.465%
Austria													2	2	0.003%
Belgium					6	7			1	6				20	0.027%
Brazil			2						2		7	1		12	0.016%
Canada		84	84	70	202	98	194	211	249	478	256	281	318	2525	3.375%
Chile						5						6		11	0.015%
China						1								1	0.001%
Costa Rica					3									3	0.004%
Croatia								6						6	0.008%
Czech Republic											9			9	0.012%
Denmark				3	1	1	1			13			9	28	0.037%
Dominican Republic					1								6	7	0.009%
Estonia									6					6	0.008%
Finland			6	48	9	14	13	17	9	32			6	154	0.206%
France		66	2	7	2	4	7	1	2	35	2	5		133	0.178%
Germany				61		21	37	96	47	108	113	62	71	616	0.823%
Greece			1		1	1				8			3	14	0.019%
Hong Kong			37						11		6			54	0.072%
Hungary			102							3			6	111	0.148%

	Aug*	Sept	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Total	Percent
Iceland			1	6				22				6	35	0.047%
India			2	2						25			29	0.039%
Indonesia					1								1	0.001%
Israel				5			1	1			2		9	0.012%
Italy			1				3	1	24			31	60	0.080%
Japan	19	9	18	9	58	46	22	51	14	54	29	12	341	0.456%
Jordan												6	6	0.008%
Kuwait				27									27	0.036%
Latvia							30						30	0.040%
Malaysia						2					10	7	19	0.025%
Malta							9	2					11	0.015%
Mexico	1	2		1	38					14	12		68	0.091%
Netherlands	42	10	8		14	4	2	25		115	6		226	0.302%
New Zealand	12				7	1	15	9		9	85		138	0.184%
Norway				11	6	8		3	5	26	70		129	0.172%
Paraguay											3		3	0.004%
Peru	1							8					9	0.012%
Poland				38	20	35				6			99	0.132%
Portugal	8		4			9		8	7		3		39	0.052%
Romania			1										1	0.001%
Russia				14									14	0.019%
Singapore	1	1	2			5		19	30	6		24	88	0.118%
South Africa		1	1				1	1				2	6	0.008%
South Korea		1	9	2				3		2			17	0.023%
Spain	5	4		1	4	8	7	20	26	33	63	18	189	0.253%
Sweden	18	2	2	21	39	37	13	2	22	72	19	6	253	0.338%
Switzerland			2		1	1			15			6	25	0.033%
Taiwan			1	19			1	2	34		10	53	120	0.160%
Thailand					1		1		40				42	0.056%
Trinidad & Tobago												9	9	0.012%
Turkey					2	1		9	8	3	2	7	32	0.043%
Venezuela								1					1	0.001%
United Kingdom	4	23	26	1	16	15	15	91	43	51	9	2	296	0.396%
Numerical (unidentified user)	940	982	1324	1564	1211	1252	1892	3340	5190	3586	1614	2371	25266	33.768%

* August data interpolated from July and September values

Table 2. Subscribers to the fws-shorebirds-digest List Server in 1996 and 1997

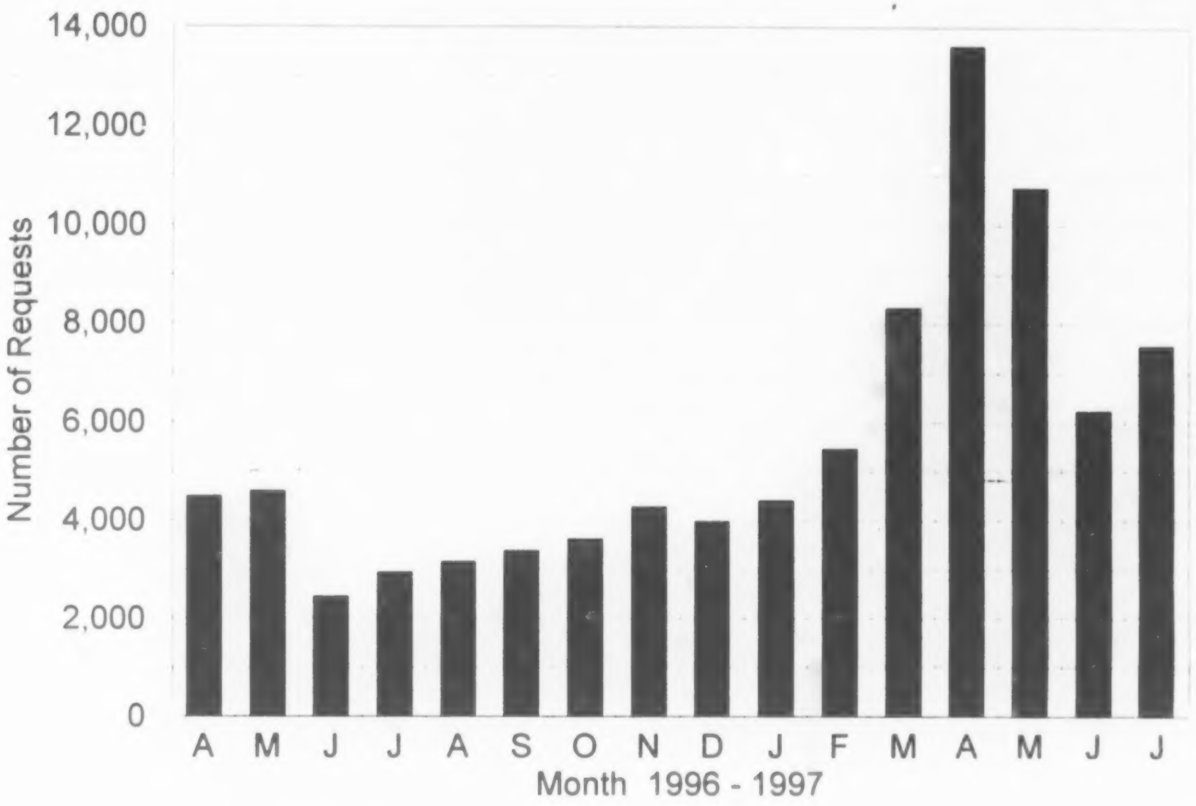
	1996*	1997**
Total Number of Subscribers	**180**	**640**
United States (subtotal)	**153**	**563**
U. S. Commercial (.com)	47	209
U. S. Educational (.edu)	36	80
U. S. Government (.gov)	28	60
U. S. Military (.mil)	3	13
United States (.us)	10	42
Networks (.net)	22	123
Non-Profit (.org)	7	36
Other Countries (subtotal)	27	77
Argentina		1
Australia	3	6
Brazil		4
Canada	16	29
Chile		1
Columbia		1
Costa Rica		2
Cuba		1
Ecuador		1
Estonia	1	
France		1
Germany	1	1
Ireland		1
India		1
Japan	1	2
Mexico		12
Netherlands		2
Portugal		1
Russia		1
South Africa	1	1
Spain		2
Surinam		1
Sweden	1	
Taiwan	1	3
United Kingdom	2	2

* Average of April and May 1996

** November 1997

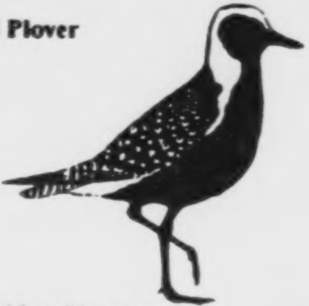
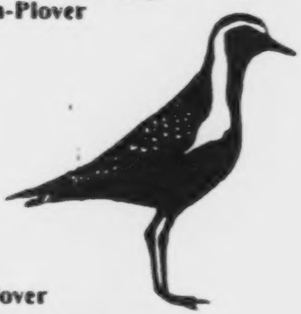
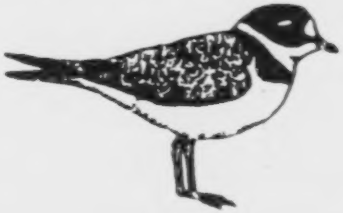
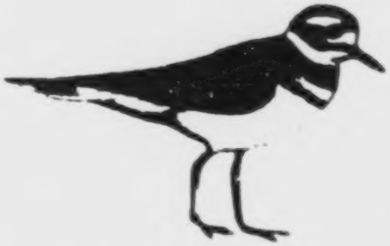
Figure 1. Requests from the Web Page

Shorebird Sister Schools Program



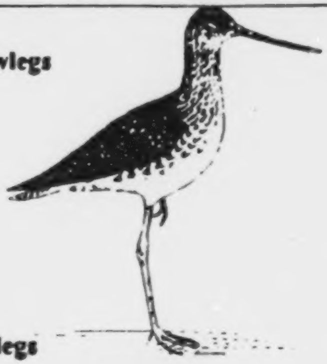
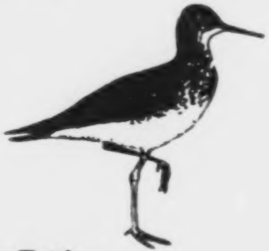
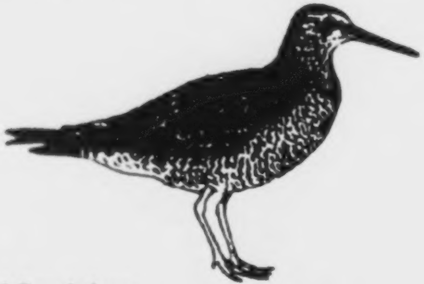
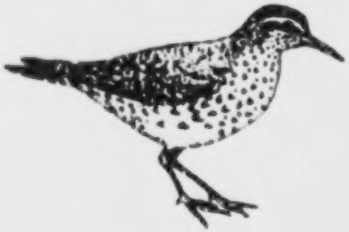
FACTSHEET ON SOME COMMON SHOREBIRDS

March 1994 © G. C. West

Species	Description	Nests	Winters (in Western Hemisphere)	Migrates (to Alaska)
Black-bellied Plover 	11" Black belly, white neck stripe, speckled black and white back. In small groups at or above tide line.	Arctic and coastal tundra of northern and western Alaska and coasts of arctic Canada and Russia.	Coasts from Vancouver, BC and New England south to Chile and Argentina.	Along Pacific coast.
American Golden-Plover 	11" Black belly, white neck stripe, speckled gold and brown back. Alone or in small groups usually above the tide line.	Arctic and alpine tundra of northern and interior Alaska and northern Canada.	Pampas of central South America.	Through interior North America.
Semipalmated Plover 	7" Black breast band, uniform brown back, white forehead, base of bill orange. In pairs or small groups above tide line.	Vegetated beaches, river bars, lake margins, throughout Alaska and northern Canada.	Coasts from southern California and North Carolina to southern South America.	Along Pacific coast and through interior North America.
Killdeer 	11" Two black breast bands, uniform brown back, white facial markings, rusty rump and tail. In small flocks or pairs in wet meadows.	Wet meadows and grasslands from southeastern Alaska across Canada and the lower 48 states.	Wet meadows from Washington and North Carolina across the U.S. south to Peru.	Along Pacific coast and through interior North America.

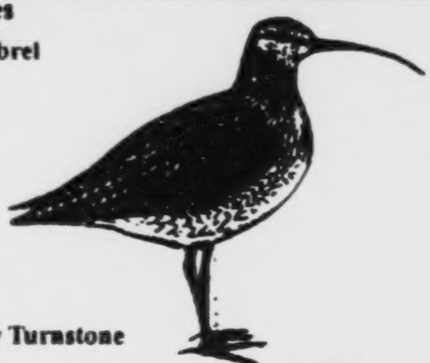
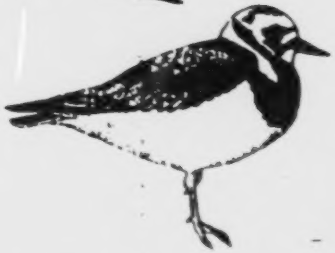
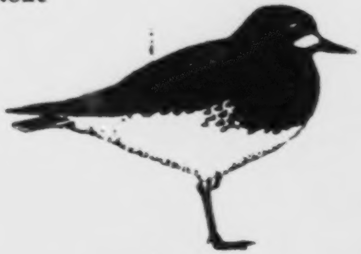
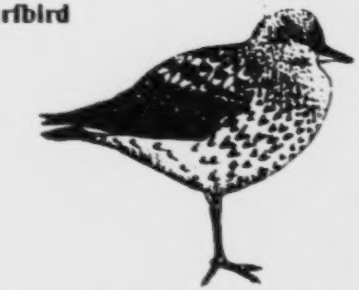
FACTSHEET ON SOME COMMON SHOREBIRDS

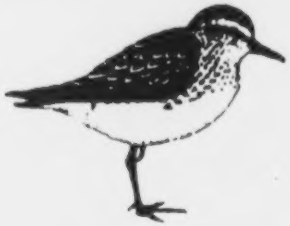
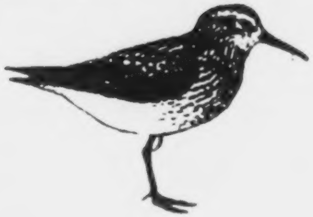
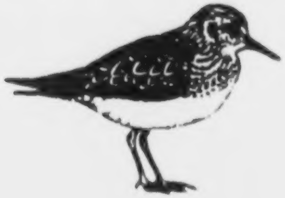
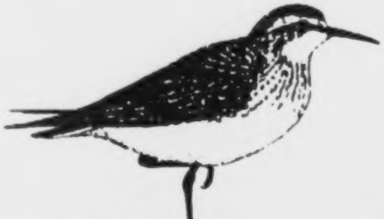
March 1994 © G. C. West

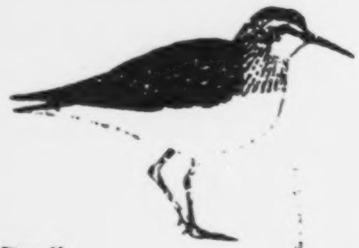
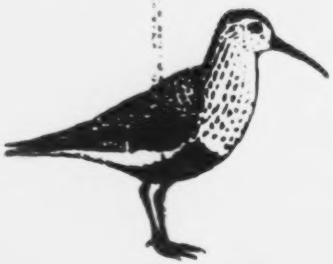
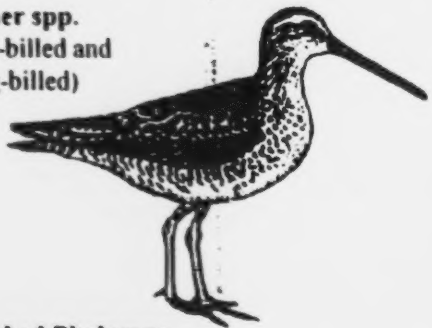
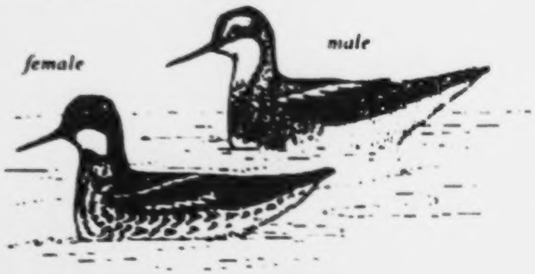
Species	Description	Nests	Winters (in Western Hemisphere)	Migrates (to Alaska)
Greater Yellowlegs 	14" Gray speckled plumage, white base of tail, long bright yellow legs, long, slightly upturned bill. In small groups at tide line or in shallow water.	Marshes, lake margins, and wet areas from southcentral Alaska across central Canada.	Coasts and grasslands from California and Delaware south throughout South America.	Along Pacific coast and through interior North America.
Lesser Yellowlegs 	10" Gray speckled plumage, white base of tail, long bright yellow legs, bill shorter and straighter. In small groups, in marshes and fresh water ponds.	Wet tundra and muskeg throughout Alaska and Canada.	Coasts in U.S. from southern California and Delaware south throughout South America.	Along Pacific coast and through interior North America.
Wandering Tattler 	11" Uniformly gray above, heavily barred below, short green-yellow legs. In small groups on rocky or gravel beaches.	Alpine tundra near streams of central, western, and southern Alaska and northwestern British Columbia.	Coasts of southern California and western Mexico and South Pacific Islands.	Along Pacific coast and from Hawaii to the Aleutians.
Spotted Sandpiper 	7" Uniformly brown above, heavily spotted below, bobs body. Alone or in small groups on gravel beaches and along rivers and lakes.	Lake and river margins throughout Alaska, Canada, and the lower 48 states.	Coasts from Washington and Georgia south and in wetlands into Argentina.	Along Pacific coast and through interior North America.

FACTSHEET ON SOME COMMON SHOREBIRDS

March 1994 © G. C. West

Species	Description	Nests	Winters (In Western Hemisphere)	Migrates (to Alaska)
Whimbrel 	18" Speckled and streaked brown plumage, striped head, long down-curved bill. In small groups on mud flats and in open fields.	Alpine and arctic tundra of western and northern Alaska, western arctic Canada, Scandinavia, and eastern Russia.	Coasts from California and North Carolina south to Chile and Brazil.	Along Pacific coast.
Ruddy Turnstone 	9" Rusty back, distinctive black-and-white facial pattern, red legs, white wing, back, and tail patches. Usually with large flocks of Black Turnstones.	Arctic coastal tundra of northwestern and northern Alaska, northern Canada, northern Scandinavia, and northern Russia.	Coasts from California and Delaware south to Chile and Brazil.	Along Pacific coast.
Black Turnstone 	9" Black above and on chest, white spots on face, dark legs, white wing, back, and tail patches. In large flocks on rocky and gravel beaches, often with Surfbirds.	Coastal salt marsh tundra of western Alaska.	Coasts from southeastern Alaska to northern Mexico.	Along Pacific coast.
Surfbird 	10" Speckled brown-gray above, rusty shoulders, speckled below, stubby body, yellowish legs, white wing and tail patches. In large flocks on rocky and gravel beaches, often with Black Turnstones.	Alpine tundra of interior Alaska.	Coasts from southeastern Alaska to Tierra del Fuego.	Along Pacific coast.

Species	Description	Nests	Winters (in Western Hemisphere)	Migrates (to Alaska)
Semipalmated Sandpiper 	6" Speckled brown plumage, short black bill, black legs, little rusty on shoulders. In small numbers often with flocks of Western Sandpipers along the tide line.	Arctic tundra from Seward Peninsula, north and east across arctic Canada.	Coasts from southern Central America south to Ecuador and Brazil.	Along Pacific coast and through interior North America.
Western Sandpiper 	6" Speckled brown plumage, longer bill droops at tip, black legs, rusty on cap, face, and shoulders. In large flocks on mud flats.	Arctic tundra from Yukon Delta north and east to Barter Island and far eastern Siberia.	Coasts from California and North Carolina to Ecuador and Venezuela.	Along Pacific coast and through interior North America.
Least Sandpiper 	5" Speckled warm-brown plumage, short thin bill, yellow legs. In small groups or pairs, above the tide line, often in grassy areas.	Coastal marsh and around fresh water lakes and wet areas throughout Alaska and northern Canada.	Marshes and coasts from California and Georgia through central S America.	Along Pacific coast and through interior North America.
Baird's Sandpiper 	8" Speckled gray-brown plumage, buffy breast, black legs, straight thin black bill. Alone or in small groups on mud flats or in grassy areas above the tide line.	Coastal arctic tundra of western and northern Alaska, arctic Canada, and far eastern Siberia.	Grasslands of southern South America.	Interior North America.

Species	Description	Nests	Winters (In Western Hemisphere)	Migrates (to Alaska)
Pectoral Sandpiper 	8" Speckled warm-brown plumage, breast streaks end in line across breast, yellow legs, dusky yellowish bill. In small groups, usually in grassy areas.	Coastal arctic tundra of western and northern Alaska, northern Canada, and northern Siberia.	Grasslands of southern South America.	Interior North America
Dunlin 	8" Speckled red-brown plumage, black belly patch, black bill droops at tip, black legs. In large flocks on mud flats.	Wet coastal tundra of western Alaska, central northern Canada, northern Scandinavia, and northern Russia.	Coasts from California and Delaware south to northern Mexico.	Along Pacific coast.
Dowitcher spp. **(Short-billed and Long-billed)** 	11" Speckled brown plumage, rusty below with dark spots, very long straight bill, dull yellow-green legs, white back stripe in flight. In small flocks, often in the water below the tide line.	Short-billed in marshes of south coastal Alaska across central Canada; Long-billed on coastal tundra of western and northern Alaska and northern Siberia.	Short-billed on coasts from California and Georgia south to Ecuador and Brazil; Long-billed in wet areas from Washington and Georgia to Central America.	Along Pacific coast and through interior North America.
Red-necked Phalarope  	8" Gray (female) or brown (male) head, white throat, red neck stripe, thin straight bill. Swims in water. In large flocks on salt water and in pairs in fresh water.	Fresh water ponds and marshes throughout Alaska, northern Canada, Scandinavia, and northern Russia.	At sea in Pacific and Atlantic Oceans to southern South America.	Across the Pacific Ocean and along the coast.

SHOREBIRD SISTER SCHOOLS PROGRAM

Internet Address:
http://www.fws.gov/r7enved/sssp.html
U.S. Fish and Wildlife Service, Alaska
Division of External Affairs

Cruise the Super Shorebird Highway!

Each year, arctic-nesting shorebirds migrate from their wintering grounds in Latin America, Hawaii and Australia to their nesting grounds in Alaska and the Canadian Arctic. Shorebird migration is one of the most fascinating of all migrations; some shorebirds fly thousands of miles without stopping to rest or feed. Now students from all over the Western Hemisphere can track arctic-nesting shorebirds along their migration routes and share their field experiences with other students.

Students

Get on-line and learn about shorebird ecology and migration. Discover amazing facts about shorebirds and find fun activities to test your biology skills. Sign up for the free shorebird list server through your electronic mailbox. Ask biologists questions about shorebirds, document the shorebird sightings in your area, and receive mail from other students from around the world.

Teachers

Within the Shorebird Sister Schools Program you will find a variety of multidisciplinary activities for the classroom and an extensive section on how to conduct a shorebird field trip. Help your students learn about shorebird migration and ecology and about the variety of cultures of students throughout the Western Hemisphere.

List Server

Subscribing to the list server is easy... and it is free! Simply send e-mail to listserv@www.fws.gov with "subscribe fws-shorebirds-digest Your Full Name" in the body of the message.

Questions??

For more information on the Shorebird Sister Schools Program contact Environmental Education Specialist, Heather Johnson, at (907) 786-3367 or send an e-mail to Heather _Johnson@mail.fws.gov.

drawings by G.C. West

Stand on one leg
Laugh
Flap one wing

Laugh
Bow
Spread wings

Pull head down into
shoulders
Stamp feet
Flutter one wing at a time

Hunch back
Tremble with whole body
Scuttle sideways

Hop sideways
Jerk head
Call out, “Cheer, cheer”

Croak
Wing flash
Dip head

Bend knees
Turn head from side to side
Hum

Open and close bill
Stamp feet
Beat wings slowly

Rear up and spread wings
Hoot
Walk with stiff legs

Whistle
Droop wings
Stamp feet

March in place
Shake head
Laugh

Flap wings slowly
Hoot
Extend neck

Vibrate your wings
Lunge head-first
Gurgle

Shake your rump
Spin in a circle
Call out, “Keer, keer”

Teeter (like a see-saw)
Scrape with your feet
Give a high trill

Peck the ground
Look behind you
Hop

Zig-zag run
Rear up and spread wings
Call softly

Open and close your bill
slowly
Caw
Hop sideways

Bob head swiftly
Jump in a circle
Chatter your bill

Vibrate your wings
Call softly
Do knee-bends

Clap your wings together
Waggle your head
Whistle

Scrape with foot
Shake head
Crouch

Kick feet backwards
Spread wings
Say, “Keek, keek”

Walk sideways
Say, “Peep, peep”
Flap wings fast

Spin in circles
Say, “Keek, keek”
Bow

Hunchback walk
Flap wings fast
Nod head

Walk with stiff legs
Gargle
Shake head

Habitat

a place where organisms are adapted to live and find food and shelter

Wetland

land that is covered or saturated (soaked) with water at least part of the time

Alpine

habitat found at heights above treeline

Ocean beach

sandy habitat affected by the tides (oystercatchers live here and migrating Sanderlings rest and feed here)

Mudflat

mud habitat that is
exposed at low tide and is
a home to many
invertebrate animals

Freshwater marsh

inland habitat where the roots of grasses, sedges, and rushes are always under water

Saltwater marsh

coastal habitat made of ocean water and plants that are adapted to salt water

Tundra

northern wetland habitat with permafrost and no trees

Intertidal zone

nutrient-rich, rocky beach habitat between high and low tide mark

Muskeg

northern bog of moss and small spruce trees

Roost

a flock of resting shorebirds (also the name for the place where they rest together at night or during migration)

Tide

the daily movement of
ocean water (caused by
the gravity of the sun and
the moon pulling on it)

Sphagnum moss

a small wet plant which
soaks up moisture—lives
in muskeg and other wet
places

Permafrost

permanently frozen
subsoil of the tundra

Migration

the regular movement of
birds (or other animals)
every spring and fall

Scrape

a shallow nest excavated
in sand, gravel, or soil
(may be lined with bits of
shells or grasses)

Stop-over sites

important habitats where shorebirds stop every year to rest and feed during migration

Shorebird non-breeding season

winter (if it occurs in the northern hemisphere)

Shorebird breeding season

summer (if it occurs in the northern hemisphere)

Shelter

where organisms are protected from predators or environmental conditions

Food

for Western Sandpipers, includes tiny clams and worms in the winter, and insects in the summer

Macoma clam

shorebird food item found on Pacific beaches

Crustacean

a group of animals that
includes small shrimp and
crabs that shorebirds,
especially phalaropes,
feed on

Copper River Delta

a migration stop-over site
near Cordova, Alaska

Montague Island

a surfbird migration stop-over site in Prince
William Sound

Stikine River Delta

a migration stop-over site
in Southeast Alaska

Nelson Lagoon

a migration stop-over site
on the northern part of the
Alaska Peninsula

Yukon Delta

a migration stop-over site
west of Bethel, Alaska

North Slope

breeding grounds for
many shorebirds north of
the Brooks Range

South America

a large continent where many arctic-nesting shorebirds spend their nonbreeding season

Hawaii

a state where you might find Pacific Golden Plovers in the winter

Canada

a Nearctic country that contains vast amounts of tundra habitat (particularly high, rocky tundra)

Russia

a country that extends north into the Palearctic, and east towards Alaska

Nearctic

the North American arctic region

Palearctic

the Northern Europe and Asian arctic region

I’m going to get that clam
before that other
sandpiper does!

This is good food for you,
chicks.

If I don’t move, maybe
that fox won’t see me on
my nest.

This looks like the stop-over site I remember from last migration.

This looks like a good spot to roost.

What happened to my mom? I can't see or hear her!

I'm trying to roost but the ATV's are frightening me so I can't sleep.

These worms and snails
are absolutely delicious!

Where are you all?

I hear my mate calling
me.

I wonder if there's any
food around here.

I'm tired and hungry but
my stop-over site has
been drained and paved.

I'm frightened but I'm
going to try to keep you
away from my eggs
anyway.

This used to be a good
spot to nest, but this year
it's too dirty.

I feel sick.

I am weak and tired.

I see a fox—all you
chicks need to freeze.

My eggs are gone!

Get out of here!

There's a lot of food over here!

What's that strange noise?

I am very hungry.

I am a wounded rabbit
and you can catch me.

My leg is broken—you
can easily catch me.

Come catch me: I'm a
little mouse.

Where do you want to
build the nest?

I’m about to attack you.

I’m afraid.

I think I see a predator!

Come back here, chicks!

This is my territory—I
want you to get out!

This is my territory and I want you to stay and nest here.

It's time to migrate.

Look at me!

I like you.